N61165.AR.004018
CNC CHARLESTON
5090.3a

CORRECTIVE ACTION PLAN FOR SITE I8 BUILDING 123 ZONE G SITE IDENTIFICATION # 16763 AND SITE 19 AST 3909 ZONE G SITE IDENTIFICATION NUMBER 01093 WITH TRANSMITTAL CNC CHARLESTON SC
4/1/2001
J A JONES ENVIRONMENTAL SERVICES

CORRECTIVE ACTION PLAN
FOR
SITE 18, BUILDING 123, ZONE G
Site Identification # 16763

and

SITE 19, AST 3909, ZONE G
Site Identification # 01093

Charleston Naval Complex
Charleston, South Carolina

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Contract Number N62467-99-C-0960

April 2001

JA Jones Environmental Services

TRANSMITTAL FORM

Project:	**Charleston Naval Shipyard**
DO Title:	Delivery Order '024
DO Project Location:	Charleston Naval Complex

Date: 24-Apr-01	**To:** Michael Bishop SCDHEC 2600 Bull Street Columbia , SC 29201-1708 803-898-4339	**From:** Brian R. Crawford J.A. Jones Environmental Services 1849 Avenue F North Charleston, South Carolina 29405 (843) 740-2780
Contract Number :		
Delivery Order Number		
024		
File Number		
0		

JAJ Subcontract Number	**Subcontractor/Supplier/Manufacturer:**	**Transmitted for:**	
na		Approval/Comment	
JAJ P.O. Number		Final document	
na		Information	X
Change Order Number		As requested	X
na		Fabrication	
Transmittal Number		Field Use	
001-C024		Other	

Specification Section Number or Drawing	Qty	Description of Submittal	Date	Comments	Number of Copies
	1	CAP Site 18-19 and 200	04/30/01		1

SENT		**GENERAL COMMENTS**
Enclosed	X	Original
Separate		
Fed Ex	X	
Mail		
Other		
Other		

CC:	Project File	Dean Williamson
	Gary Foster	Scott Tarmann
	Gabe Magwood	
	Tony Hunt	

Signed:

Brian R. Crawford, Engineer II

CORRECTIVE ACTION PLAN
FOR
SITE 18, BUILDING 123, ZONE G
Site Identification # 16763

and

SITE 19, AST 3909, ZONE G
Site Identification # 01093

Charleston Naval Complex
Charleston, South Carolina

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston, South Carolina 29406

Submitted by:
CH2M-JONES, LLC.
Charleston Navel Complex
1849 Avenue F
North Charleston, South Carolina 29405

Contract Number: N62467-99-C-0960

April 2001

CERTIFICATION

I certify that the information contained in this report is true, and complete to the best of my knowledge, information, and belief.

Approved By:_____ Date:_____

South Carolina Registration No. _____

ACRONYMS

AST	Aboveground storage tank
bls	below land surface
BTEX	benzene, toluene, ethylbenzene and xylenes
BRAC	Defense Base Realignment and Closure Act
CAP	Corrective Action Plan
CNC	Charleston Naval Complex
CoC	Chemical of Concern
DOT	Department of Transportation
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EPA	Environmental Protection Agency
ft bls	feet below land surface
mg/kg	milligram per kilogram
mg/L	milligram per liter
OVA	Organic Vapor Analyzer
PAHs	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RA	Rapid Assessment
RAR	Rapid Assessment Report
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation Recovery Act
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSTL	Site-Specific Target Level
SWMU	Solid Waste Management Unit
TtNUS	Tetra Tech NUS
UST	Underground Storage Tank
µg/L	micrograms per liter

TABLE OF CONTENTS

1.0 INTRODUCTION

This Corrective Action Plan (CAP) has been prepared by CH2M-JONES, LLC. The plan is designed for Site 18, Building 123, Zone G and Site 19, AST 3909, Zone G; located at the Charleston Naval Complex (CNC), Charleston, South Carolina. Site 18 contains the location of a former petroleum Underground Storage Tank (UST) system used to store waste oil from the oil/water separator from the boiler systems at the Boiler House building. Site 19 contains the location of a former Aboveground Storage Tank (AST) system used to supply fuel oil for the boilers. The South Carolina Department of Health and Environmental Control (SCDHEC) has designated Site 18 with Identification Number 167673 and Site 19 with Identification Number 01093.

This CAP provides a method for active remediation of the sites by removing petroleum affected soils and free-phase petroleum product identified in the vicinity of the former UST basin; conducting groundwater sampling to evaluate the active remediation of the site; and implementing intrinsic remediation and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. The CAP was developed using the information provided in the Rapid Assessment Report (RAR) for Sites 18 and 19 prepared by Tetra Tech NUS, Inc. (TtNUS), dated May 2000. The applicable tables and figures from the RAR have been incorporated into this CAP.

1.1 GENERAL SITE DESCRIPTION

The CNC is located in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina (Figure 1). This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base (Figure 2).

The area surrounding CNC is "mature urban", having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A site vicinity map, which exhibits adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2.

1.2 SITE BACKGROUND

The CNC began operations in 1901, when the Navy acquired the property. In 1993, the CNC was added to the list of bases schedule for closure under the Defense Base Realignment and Closure Act (BRAC). BRAC regulates the closure of the base and transition of the property back to the community. With the scheduled closure of the base, environmental cleanup has proceeded to make the property available for redevelopment after closure.

Building 123 is the former Boiler House, constructed in 1997, which supplied steam to ships and parts of the base at CNC. There was one UST and one AST associated with Boiler House systems. The UST was used to store waste oil from the boiler systems oil/water separator. The Site 18 UST was a 1,000-gallon steel tank installed in 1997 on the north side of Building 123 (Figure 3). The AST was used to store the fuel oil supply for the boiler systems. The Site 19 AST was a 200,000 gallon steel tank installed in 1964 on a concrete foundation. The AST is located approximately 160 feet east of building 123 (Figure 3).

The UST and AST tank removals and closures were completed on June 20, 1996 and February 6, 1998, respectively. Petroleum-contaminated soil and groundwater was identified during the removal activities based upon soil sampling results. Excavated soil was returned to the original tank basins. A SCDHEC UST Assessment Report and AST Assessment report were completed by SPORTENVDETCHASN in 1996 and 1998, respectively. Strong petroleum odors were observed in the excavations. Groundwater with a sheen was encountered in the UST excavation. A laboratory analytical sample was collected from the groundwater in the excavation.

The site lies within the Resource Conservation Recovery Act (RCRA) designated Solid Waste Management Unit (SWMU) 178, which has been identified because of Polychlorinated Biphenyls (PCBs). No PCBs were detected in soil samples in the tank closure activities (SPORTENVDETCHASN, 1997).

From April 1999 through April 2000, TtNUS completed a Rapid Assessment (RA) for Sites 18 and 19. The information from the Rapid Assessment Report (RAR), prepared by TtNUS, dated May 2000, is summarized in Section 2.0 of this report. The RAR was approved by SCDHEC on May 19, 2000.

2.0 RAPID ASSESSMENT SUMMARY

TtNUS completed a Rapid Assessment Report (RAR), dated May 2000, for Sites 18, Building 123, and Site 19, AST 3909, Zone G. The assessment information was used to develop this CAP. The information from the RAR is summarized in this section.

2.1 RECEPTOR SURVEY

A receptor survey of the site vicinity was conducted by TtNUS personnel to identify potential receptors for petroleum hydrocarbon contamination. Figure 2 depicts the public utilities located within 250 feet of the former UST and AST study areas. The receptor utilities located on or near the site include sanitary sewer, potable water, saltwater distribution, compressed air, and electrical. Specific information concerning the depth of utilities below land surface is currently unavailable, however, utilities at this site generally are between 2 to 6 feet below land surface (ft bls).

A survey of groundwater users within a 7-mile radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no shallow potable water wells or irrigation wells within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to UST 123 and AST 3909 is the Cooper River located approximately 150 feet to the northeast.

There are no city, county or state-zoning ordinances, the property (CNC) is currently owned by the federal government. Information concerning zoning ordinances was obtained from the SOUTHDIV Remedial Project Manager located at 2155 Eagle Drive, North Charleston, South Carolina 29406.

2.2 SOIL AND GROUNDWATER ASSESSMENT RESULTS

From April 27 through September 9, 1999, TtNUS conducted field activities for the RA, which included the installation and sampling direct push soil borings, shallow monitoring wells, and temporary and permanent piezometers (vertical delineation wells). Six (6) previously installed wells (FDS01A, FSD01B, FSD01C, FSD01D, FSD01E and FSD01F) were also included in the assessment. With the exception of the temporary piezometers, sample locations are shown on Figure 3. The soil and groundwater field and laboratory sampling data from the RA is summarized in Tables 1 through 9.

As reported in the RAR, the site lithology consists of silty sand and gravel from ground surface to approximately 2 feet below land surface (ft bls), underlain by organic clay to silty clay to approximately 14 ft bls. Silty sands underlie the clay to approximately 30 feet bls. A silty clay with shell fragments was then encountered to approximately 38 feet bls, the maximum depth of the borings. Two geologic cross sections of the site are depicted in Figures 4 and 5. Groundwater levels ranged from 2 to 6 ft bls (Table 1). Groundwater is influenced on site by tidal fluctuations. The wells for Sites 18 and 19 exhibited tidal fluctuation of 0.2 to 1.16 feet. Based upon groundwater level measurements collected on

September 9, 1999, surficial groundwater flow is to the east-northeast; a groundwater potentiometric map for this date is presented in Figure 6.

During the RA, naphthalene soil contaminant concentrations exceeded Risk-Based Screening Levels (RBSLs) established by SCDHEC (Risk-Based Corrective Action For Petroleum Release, January 5, 1998) (Table 7) in samples collected from Site 18, UST 123. No soil contaminant concentrations exceeded the RBSLs in the samples collected from Site 19, AST 3909.

During one groundwater measurement event on September 9, 1999, free product was detected in one well location with a measurement of 3.1 feet thickness (Table 1). The areal extent of free product is depicted on Figure 7. For concentrations of wells containing free product, the maximum solubility in equilibrium with fuel oil was calculated using Raoult's Law. Calculated concentrations for benzene, toluene and naphthalene in equilibrium with free product exceeded their respective RBSLs (Appendix G, TtNUS, May 2000). In addition to the presence of free product, benzene and naphthalene groundwater contaminant concentrations exceeded RBSLs (Table 8) at other well locations. The distribution of Chemicals of Concern (CoC) in groundwater is presented in Figures 8 and 9.

Following aquifer characterization, TtNUS determined the fate and transport parameters during the RA in order to assess the contaminant plume behavior (Appendix F, TtNUS, May 2000). As illustrated in Figure 10, the Domenico model was used to predict the distance at which the tip of the contaminant plume is attenuated to SCDHEC RBSLs in 10 and 20 years, respectively.

2.3 DEVELOPMENT OF SITE-SPECIFIC TARGET LEVELS (SSTLS)

In the RA, TtNUS evaluated the receptor characterizations of the potentially exposed populations in the vicinity of the site for current and future land use scenarios and identified the potentially complete exposure pathways for those receptors. The evaluation resulted in two applicable scenarios for the calculation of SSTLs: on-site construction worker exposure to soil and groundwater and surface water exposure (Cooper River). No other exposure routes pathways were considered likely threats. The exposure pathway analysis is summarized in Tables 10 and 11.

The Tier 2 evaluation of the on-site construction worker in a utility trench scenario indicated that on-site soil contaminant concentrations do not exceed the RBSLs for ingestion or dermal contact with near surface soil. The minimum groundwater SSTLs for the on-site construction worker scenario and surface water exposure (impact to the Cooper River) were calculated and evaluated for each CoC. Source contaminant concentrations of benzene and naphthalene in groundwater exceeded the minimum calculated SSTLs protective of a construction worker in a utility trench and the Cooper River. The table below compares the soil and groundwater contaminant concentrations to the soil RBSLs and calculated groundwater SSTLs.

Chemical of Concern	Maximum Concentration in Soil (mg/kg)	Tier 2 Soil RBSLs (mg/kg)	Maximum Concentration in GW (µg/L)	Tier 1 GW RBSLs (µg/L)	GW SSTLs for CW (µg/L)	GW SSTLs for CR (µg/L)
Benzene	<0.9	200	***310***[a]	5.0	150	53
Toluene	<0.9	410,000	**4,650**[a]	1,000	5,380	10,617
Naphthalene	7.25	41,000	***23,350***[a]	10	1,630	106

[a] Groundwater concentration in equilibrium with free product as calculated using Raoult's Law.
RBSLs = Risk Based Screening Levels
GW = Groundwater
CW = Construction Worker
CR = Cooper River
Tier 2 Soil RBSLs are from Risk Based Corrective Action for Petroleum Releases, Table B6, Ingestion or Dermal Contact with Surficial Soil, SCDHEC Guidelines, 1998.
Tier 1 Groundwater RSBLs are from Risk Based Corrective Action for Petroleum Releases, Table B1, SCDHEC Guidelines, 1998.
Bold text indicates the concentration exceeds the RBSL.
Bold and italicized text indicates the concentration exceeds the SSTL protective of the construction worker.
Bold and italicized text and shaded cells indicates the concentrations exceed the SSTL protective of the Cooper River.

3.0 PROPOSED CORRECTIVE ACTION

This CAP provides a method for active remediation of the site by removing free petroleum product identified in the vicinity of the former UST 123 piping trench; conducting groundwater sampling to evaluate the active remediation of the site; and implementing intrinsic remediation and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. Based on the results of the RA, source removal of free petroleum product will be performed at this site to remove CoCs from groundwater and to reduce contaminant concentrations below SSTLs. At which time, intrinsic remediation will be implemented until contaminant concentrations decrease below RBSLs or action levels approved by SCHDEC. The proposed active remediation plan is described in Section 4.0, and the proposed intrinsic remediation plan is described in Section 5.0.

3.1 SOIL REMEDIATION

Because no soil contaminant concentration exceeded Tier 2 RBSLs in the RA, active soil remediation as a part of this CAP is not warranted at this time.

3.2 GROUNDWATER REMEDIATION

Free product and groundwater contamination was identified in the vicinity of the former UST 123 piping trench. The maximum source concentrations for groundwater were calculated based upon the presence of free product using Raoult's Law. The calculated contaminant source concentrations in groundwater exceeded the minimum calculated SSTLs protective of a construction worker in a utility trench and the Cooper River. Therefore, the active groundwater remediation of the site will include the removal of free product identified in the vicinity of the former UST 123 piping trench and groundwater sampling to evaluate the active remediation of the site.

The following document was used as a source for remedial design: United States Environmental Protection Agency (EPA), 1996, EPA How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites. Three approaches were considered for free product recovery: passive removal/skimmer system, bioremediation (injection), and dual-phase vapor and groundwater recovery.

Additional depth to groundwater and free product measurements were conducted on March 12 and 26, 2001 at well locations FDS01A, FDS01C and FDS01D. No free product was measured in wells FDS01C and FDS01D during the two events. The thickness of free product measured in FDS01A was 1.95 feet on March 12, 2001 and 1.97 feet on March 26, 2001. Using data obtained from the RAR and the recent free product measurements, the area of free product is estimated to be 180 square feet with an average thickness of 2 feet over the affected area (see Figure 7).

A free product bail down test was also conducted on March 27, 2001 to determine recovery rates for further definition of the appropriate corrective action. Free product thickness was

measured at 2.02 feet prior to removal. After 90 minutes, the thickness of free product was measured at 0.09 feet. Based on this information, the rate of free product recovery is estimated at 0.23 gallons per day (see table and calculations below).

Time	Depth to Product (feet below TOC)	Depth to Groundwater (feet below TOC)	Free Product Thickness (feet)
11:11 am	sheen	6.88	<0.01
11:16 am	6.45	6.49	0.04
11:21 am	6.32	6.38	0.06
11:26 am	6.23	6.27	0.04
11:31 am	6.15	6.23	0.08
11:36 am	6.11	6.18	0.07
11:41 am	6.07	6.15	0.08
11:46 am	6.05	6.12	0.07
11:51 am	6.04	6.11	0.07
11:56 am	6.02	6.10	0.08
12:01 pm	6.02	6.10	0.08
12:11 pm	6.01	6.09	0.08
12:16 pm	6.00	6.08	0.08
12:21 pm	6.00	6.08	0.08
12:26 pm	5.99	6.08	0.09
12:31 pm	5.99	6.08	0.09
12:36 pm	5.99	6.08	0.09
12:41 pm	5.99	6.08	0.09

TOC = top of casing

Free Product Recovery Rate:

$$\pi (r_w)^2 \times 7.48 \text{ gallons/cubic foot} \times \frac{FP_f}{\Delta time} = \text{Recovery Rate}$$

where,

r_w is the inner well (PVC) diameter = 0.083 feet
FP_f is the final free product thickness = 0.09 feet
Δtime is the length of test = 90 minutes

Due to the limited affected area of free product and low recovery rate estimated at the site, the following remedial strategy was designed for the Site 18:

Step 1: Initially, a dedicated, free product bailer will be utilized to remove free product. Extreme care will be taken to lower the bailer into the well to the level at which only product will be removed, to minimize the amount of contaminated groundwater mixed with the product recovery process. The bailer will be brought to the surface

and emptied into a DOT-approved 55-gallon drum. Free product will be manually removed by bailer until less than 0.01 inch of measureable product is observed.

Step 2: If the amount of product removed each time by bailer increases and the recharge rate is constant, or product becomes present in other wells where it was previously non-existent, a passive removal/skimmer system will be implemented at the site to remove free product. A passive, floating skimmer with a product recovery filter canister is designed to remove free product down to a sheen or thickness of 0.01 feet thickness. Typically, the skimmer is lowered into the well until the midpoint of the skimmer is located at the fluid level in the well. Floating hydrocarbons (free product) enters the skimmer through the floating intake outer debris screen and then through an inner oileophilic hydrophobic screen, and down into a clear canister for storage. To empty the skimmer, the device is brought to the surface, and the canister is drained using the discharge valve at the skimmer base.

Step 3: In addition, if contaminant concentrations continue to remain above the minimum calculated SSTLs after the removal of free product, enhanced bioremediation may be used to target specific locations to enhance the natural degradation of contaminants at the site. Bioremediation consists of the injection of an oxygen-enhancing compound to stimulate naturally occurring microbes with an affinity towards digesting specific contaminants under aerobic conditions. Typically, the oxygen release compound can be injected through well points that are installed into the contaminated zone using direct push technology.

4.0 PROPOSED ACTIVE REMEDIATION

Active remediation of the site will include removing free product identified in the vicinity of the former UST 123 product transfer piping and conducting groundwater sampling to evaluate the active remediation of the site. A dedicated bailer will be implemented at the site to remove free product. If the amount of product removed each time by bailer increases and the recharge rate is constant, or product becomes present in other wells where it was previously non-existent, a passive removal/skimmer system will be implemented at the site to remove free product. In addition, if groundwater contaminant concentrations do not decrease, active bioremediation may be used to target specific locations to enhance the natural degradation of the contamination at the site.

4.1 FREE PRODUCT RECOVERY SYSTEM

Free product will be removed using a dedicated bailer. Existing monitoring well FDS01A will be utilized as the free product recovery well, assuming free product is present in this well. The location of the proposed recovery well is shown on Figure 7. The bailer will be lowered into the well to the product/groundwater interface. Extreme care will be taken to minimize the amount of contaminated groundwater mixed with the product during the recovery process. The bailer will be brought to the surface and any free product and contaminated groundwater removed from the well will be containerized in DOT-approved (Specification 7H) 55-gallon drums and disposed of at a later date pending fluid contents analysis. The drums will be secured in a location coordinated with site management and base support (see Section 6.0). Free product will be manually removed by the bailer until less than 0.01 inch of measureable product is observed.

If the free product recovers at a faster rate than anticipated or becomes present in other wells, a passive, floating skimmer with a product recovery filter canister will be used for the removal of free product in recovery wells with a product thickness greater than 0.01 feet. A Tidal Passive Skimmer™, developed by Clean Environmental Equipment with extra long strokes for sites with high and low tide considerations, or an equivalent device for a 2-inch diameter well with a capacity of 0.75 liter or greater should be adequate for the conditions at the site assuming that product levels are greater than 0.01 feet in the well (Appendix A). A minimum thickness of 0.01 feet is required for the Tidal Passive Skimmer™ and most passive skimmer devices. The proposed free product skimmer system diagram is included as Figure 11.

The former UST piping trench and its associated contaminant plume will be the target area if bioremediation is warranted at the site. An SCDHEC-approved bioremediation product will be utilized at the site. The bioremediation product will be delivered into the contaminated zone through injection points typically installed using direct push technology in a grid pattern over the target area.

SCDHEC will be contacted prior to the implementation of the different remedial approaches at the site.

4.2 MONITORING WELL INSTALLATION

If any wells become unusable or new wells are warranted for any other reason, the wells will be installed to the same specification as existing monitoring wells unless site conditions change and warrant otherwise. The wells will be installed in accordance with South Carolina Well Standards and Regulations R.61-71. A utility locate will be completed prior to any well installation activities. Any necessary permits will be acquired prior to well installation activities.

4.3 SURVEYING

Surveying of any new well locations will be conducted as a part of this CAP.

4.4 SOIL BORING SCHEDULE

Because no soil contaminant concentration exceeded Tier 2 RBSLs in the RA, no soil borings are scheduled for installation in this CAP unless site conditions change and warrant otherwise.

4.5 SYSTEM OPERATION AND MAINTENANCE

System operation and maintenance will conducted every week for the first month, and a minimum of once per month thereafter. The actual frequency of sites visit will depend on the free product removal rates. During scheduled site visits, free product will be removed by hand bailing. System operation and maintenance will include the measurement of the free product level in the recovery well (FDS01A), the estimate of free product amount removed from the recovery well, and the examination of the downgradient and nearby monitoring wells (FDS01B, FDS01C, FDS01C, CNC19-MW01, CNC18-MW01 and CNC18-MW02) for free product.

4.6 SAMPLING AND ANALYSIS PLAN

During system operation and maintenance, groundwater samples will be collected at system start-up and semi-annually from monitoring wells FDS01B, FDS01C, FDS01D, CNC19-MW01, CNC18-MW01, and CNC18-MW02. Once free product has been removed from the site, one final event of groundwater samples will be collected from all monitoring wells. The groundwater samples will be submitted to a certified laboratory for analysis of benzene, toluene, ethylbenzene and xylenes (BTEX) by EPA Method 8260, and Polyaromatics Hydrocarbons (PAHs) by EPA Method 8270.

Groundwater level measurements will be collected from all monitoring wells prior to all groundwater sampling events. Measurements will be taken with an electrical water level indicator or interface probe if floating product is present. No groundwater samples will be collected if free product is measurable.

Three to six well volumes will be purged from each well prior to groundwater sampling. Field measurements of pH, groundwater temperature, specific conductance, dissolved oxygen, and turbidity will be taken during groundwater sampling events.

All sampling procedures will be conducted in accordance with EPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), 1996. Any contaminated groundwater collected during the well sampling events will be containerized in DOT-approved (Specification 7H) 55-gallon drums and disposed of at a later date pending fluid contents analysis.

4.7 REPORTING

Semi-annual monitoring reports will be submitted to SCDHEC. The reports will summarize and include copies of field and laboratory analytical data. Upon completion of active remediation, a Performance Evaluation Report will also be submitted to SCDHEC to summarizes the remediation activities, evaluate the soil and water quality data, and provide recommendations for the site.

4.8 EQUIPMENT DECONTAMINATION

All drilling equipment, augers, well casing and screens, and soil and groundwater sampling equipment involved in field sampling activities will be decontaminated according to the EPA EISOPQAM.

4.9 SAMPLE HANDLING

Sample handling will be conducted in accordance to the following references: EPA EISOPQAM, Code of Federal Regulations 136, 1990, and EPA Users Guide to Contract Laboratory Program, 1988. The following forms will be completed for packing/shipping process: sample labels, chain-of-custody labels, appropriate labels applied to shipping coolers, and chain-of-custody forms.

4.10 QUALITY CONTROL

In addition to periodic calibration of field equipment and the completions of the appropriate documentation, quality control (QC) samples will be collected during sampling events. QC samples may include field blanks, field duplicates, and trip blanks. Definitions of each can be found below as described by the EPA EISOPQAM:

- **Field Blank:** A sample collected using organic-free water, which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.

- **Field Duplicates:** Two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contamination associated with a population.

- **Trip Blank:** A sample, which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event.

They are often packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If samples are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

4.11 FIELD QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

All sampling procedures will be conducted in accordance with EPA EISOPQAM. More information on field QC can be found in Sections 4.8 through 4.10.

QA/QC specifications for selected field measurements are summarized below.

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check Calibration of OVA daily	Calibrate to manufactures specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH = 7.0	Recalibrate. If unable to calibrate, replace electrode.
Specific Conductance of water	Continuing calibration check of standard solution	> 1% of standard	Recalibrate.

4.12 RECORD KEEPING

In addition to required sampling documentation (see Section 4.9), standardized forms, log sheets and logbooks will be completed during all field activities.

5.0 PROPOSED INTRINSIC REMEDIATION

Upon completion of active remediation, if warranted, intrinsic remediation will be implemented until contaminant concentrations decrease below RBSLs or other action levels approved by SCHDEC. This CAP provides a method for implementing intrinsic remediation and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. The intrinsic remediation method may be modified based upon the results of active remediation.

5.1 MONITORING WELL INSTALLATION

Assuming the wells from the active remediation method are in good condition, no monitoring wells will be installed for the CAP. If any wells are unusable or new wells are warranted for any other reason, the wells will be installed to the same specification as existing monitoring wells unless site conditions change and warrant otherwise.

5.2 SURVEYING

No new monitoring wells are scheduled for installation as a part of the intrinsic CAP. Surveying of any new well locations will be conducted if warranted.

5.3 SOIL BORING SCHEDULE

No other soils borings are scheduled for the CAP unless site conditions change and warrant otherwise.

5.4 MONITORING WELL ABANDONMENT

All monitoring wells will be abandoned upon receiving approval by SCDHEC. The wells will be abandoned following the South Carolina Well Standards and Regulations R.61-71. The well abandonment will include grouting wells, removing stick-ups and removing all guard posts. Any well casing and screen removed will be decontaminated and disposed of as general refuse.

5.5 SAMPLING AND ANALYSIS PLAN

Groundwater samples will be collected semi-annually for a period of 18 months from monitoring wells FDS01B, FDS01C, FDS01D, CNC19-MW01, CNC18-MW01, and CNC18-MW02. The groundwater samples will be submitted to a certified laboratory for analysis of BTEX and naphthalene by EPA Method 8260, and PAHs by EPA Method 8270. The following parameters may also be considered for analysis in order to evaluate the effectiveness of intrinsic remediation: nitrate (NO^{-3}), sulfate (SO^{-4}), total dissolved iron, methane (CH_4), and alkalinity.

Groundwater level measurements will be collected from all monitoring wells prior to all groundwater sampling events. Measurements will be taken with an electrical water level

indicator or interface probe if floating product is present. No groundwater samples will be collected if free product is measurable.

Three to six well volumes will be purged from each well prior to groundwater sampling. Field measurements of pH, groundwater temperature, specific conductance, dissolved oxygen, and turbidity will be taken during groundwater sampling events.

All sampling procedures will be conducted in accordance with EPA EISOPQAM. Any contaminated groundwater collected during the well sampling events will be containerized in DOT-approved (Specification 7H) 55-gallon drums and disposed of at a later date pending fluid contents analysis.

5.6 REPORTING

Semi-annual monitoring reports will be submitted to SCDHEC. The reports will summarize and include copies of field and laboratory analytical data. Upon completion of 18 months of sampling, a Performance Evaluation Report will also be submitted to SCDHEC to summarize the sampling activities, evaluate the soil and water quality data, and provide recommendations for the site.

6.0 SITE MANAGEMENT AND BASE SUPPORT

Throughout the investigation activities, work on the CNC will be coordinated through SOUTHDIV and SCDHEC.

The primary contacts for each are as follows:

1. SOUTHDIV point of contact
   Gabe Magwood
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
   (843) 820-7307

2. SOUTHDIV point of contact
   Tony Hunt
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
   (843) 820-5525

3. SCDHEC point of contact
   Michael Bishop
   South Carolina Department of Health and Environmental Control
   2600 Bull Street
   Columbia, SC 29201
   (843) 898-4300

7.0 REFERENCES

Comprehensive Sampling and Analysis Plan (Ensafe/ Allen & Hoshall. July 1996).

South Carolina Department of Health and Environmental Control. 1997. Corrective Action Guidance.

SPORTENVDETCHASN. 1996. UST Assessment Report.

SPORTENVDETCHASN. 1998. AST Assessment Report.

Tetra Tech NUS, Inc. May 2000. Rapid Assessment Report for Site 18, Building 123 and Site 19, AST 3909, Zone G, Charleston, South Carolina.

United States Environmental Protection Agency. 1990. Code of Federal Regulations 136.

United States Environmental Protection Agency. 1996. EPA Environmental Investigations Standard Operating Procedures for Quality Assurance Manual.

United States Environmental Protection Agency. 1988. EPA How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites.

TABLES

FIGURES

APPENDIX A

REMEDIAL EQUIPMENT – PASSIVE SKIMMER

TABLES

TABLE 1

GROUNDWATER ELEVATIONS
SITE 18, BUILDING 123 and SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well #	Total Depth of Well, ft	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Water, ft (BTOC)	Depth to Product, ft (BTOC)	Product Thickness, ft	Groundwater Elevation (MSL)
FDS01A	13.0	9.75	9/9/99	9.15	6.05	3.10	3.14
FDS01B	13.0	7.69	9/9/99	4.21	ND	ND	3.48
FDS01C	13.0	9.30	9/9/99	6.00	ND	ND	3.30
FDS01D	13.0	9.46	9/9/99	6.16	ND	ND	3.30
FDS01E	13.0	6.84	9/9/99	4.68	ND	ND	2.16
CNC18-M01	12.0	7.93	9/9/99	4.68	ND	ND	3.25
CNC18-M02	12.0	6.61	9/9/99	2.77	ND	ND	3.84
CNC18-M03D	33.0	7.59	9/9/99	3.01	ND	ND	4.58
CNC19-M01	13.5	8.92	9/9/99	5.28	ND	ND	3.64
CNC19-M02	12.5	7.69	9/9/99	4.15	ND	ND	3.54
CNC19-M03	12.5	6.81	9/9/99	3.37	ND	ND	3.44
CNC19-M04	12.5	6.29	9/9/99	2.83	ND	ND	3.46
CNC19-M05	12.5	7.93	9/9/99	4.44	ND	ND	3.49

Notes:

MSL - Mean Sea Level
BTOC - Below Top of Casing
NM - Not Measured
ND- No Free Product Detected
ft - Feet

TABLE 2

GROUNDWATER FIELD MEASUREMENTS
SITE 18, BUILDING 123
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (°C)	pH	Conductivity (uMHOS/cm)
CNC18-M01	9/9/99	PP	2.1	25.5	6.87	1.51
CNC18-M02	9/9/99	PP	1.5	24.8	6.96	3.45
CNC18-M03D	9/9/99	PP	5.3	26.6	7.09	23.20
CNC18-M04	9/9/99	PP	4.5	27.0	6.89	0.72
FDS01F	9/9/99	PP	4.5	26.2	6.93	0.74

Notes:
(°C) - Degrees Celsius
PP - Peristaltic pump, low flow technique
uMHOS/cm - Micro MHOS per centimerter

TABLE 2 - CONTINUED

GROUNDWATER FIELD MEASUREMENTS
SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (°C)	pH	Conductivity (uMHOS/cm)
CNC19-MW01	8/6/99	PP	3.8	27.0	6.79	2.19
CNC19-MW02	8/6/99	PP	3.9	26.2	6.99	4.48
CNC19-MW03D	9/9/99	PP	4.5	26.5	6.64	3.16
CNC19-MW04	9/9/99	PP	5.3	26.0	6.72	3.53
CNC19-MW05	9/9/99	PP	4.0	26.8	6.37	4.21
CNC19-MW06	9/9/99	PP	1.1	27.2	7.25	1.47
FDS01B	9/9/99	PP	3.0	30.6	6.85	1.04
FDS01C	9/9/99	PP	3.5	25.9	6.72	1.72
FDS01D	9/9/99	PP	3.0	27.5	6.98	2.64

Notes:

(°C) - Degrees Celsius

PP - Peristaltic pump, low flow technique

uMHOS/cm - Micro MHOS per centimerter

TABLE 3

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
SITE 18, BUILDING 123
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/l)	Alkalinity (mg/l)	Carbon Dioxide (mg/l)	Sulfide (mg/l)	Ferrous Iron (mg/l)	Nitrite (mg/l)	Manganese (mg/l)	Nitrogen/ Nitrate (mg/l)*	Sulfate (mg/l)*	Methane (ug/l)*
CNC18-MW01	9/9/99	0.20	276	232	0.22	1.90	0.002	0.5	NA	NA	NA
FDS01E	9/9/99	0.30	330	192	0.40	0.04	0.013	0.1	NA	NA	NA

Notes:
mg/l - Milligrams per liter
ug/l - Micrograms per liter
E- Estimated Concentration
* Fixed base laboratory analysis
NA = Not analyzed

TABLE 3 - CONTINUED

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/l)	Alkalinity (mg/l)	Carbon Dioxide (mg/l)	Sulfide (mg/l)	Ferrous Iron (mg/l)	Nitrite (mg/l)	Manganese (mg/l)	Nitrogen/ Nitrate (mg/l)*	Sulfate (mg/l)*	Methane (ug/l)*
CNC18-MW03	9/9/99	0.05	544	306	0.80	2.30	0.000	0.4	NA	NA	NA
FDS01D	9/9/99	0.40	550	322	0.48	0.37	0.036	0.5	NA	NA	NA

Notes:
mg/l - Milligrams per liter
ug/l - Micrograms per liter
E- Estimated Concentration
* Fixed base laboratory analysis
NA = Not analyzed

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 18, BUILDING 123
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC18-B01	18SSB0100	0	0
	18SSB0104	3	0
CNC18-B02	18SSB0201	1	2
	18SSB0202	2	2
	18SSB0203	3	2
	18SSB0204	4	2
	18SSB0205	5	7
	18SSB0206	6	7
	18SSB0207	7	5
CNC18-B03	18SSB0301	1	8
	18SSB0302	2	8
	18SSB0303	3	8
	18SSB0304	4	8
	18SSB0305	5	8
CNC18-B04	18SSB0401	1	8
	18SSB0402	2	8
	18SSB0403	3	8
CNC18-B05	18SSB0503	3	10

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
PPM - parts per million
ND - not detected

TABLE 4 - CONTINUED

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 19, AST 3909
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC19-B01	19SSB0101	1	Not Read
	19SSB0102	2	Refusal - concrete
CNC19-B02	19SSB0201	1	5
	19SSB0202	2	5
	19SSB0203	3	5
	19SSB0204	4	>50
	19SSB0205	5	>50
CNC19-B03	19SSB0301	1	5
	19SSB0302	2	5
	19SSB0303	3	5
	19SSB0304	4	5
	19SSB0305	5	>50
CNC19-B04	19SSB0401	1	5
	19SSB0402	2	5
	19SSB0403	3	15
	19SSB0404	4	50
	19SSB0405	5	50
CNC19-B05	19SSB0501	1	5
	19SSB0502	2	5
	19SSB0503	3	5
	19SSB0504	4	20
	19SSB0505	5	>20
CNC19-B06	19SSB0601	1	3
	19SSB0602	2	3
	19SSB0603	3	3
	19SSB0604	4	20
	19SSB0605	5	20
CNC19-B07	19SSB0701	1	3
	19SSB0702	2	3
	19SSB0703	3	3
	19SSB0704	4	3
	19SSB0705	5	3
CNC19-B08	19SSB0801	1	4
	19SSB0802	2	4
	19SSB0803	3	4
	19SSB0804	4	5
	19SSB0805	5	>30

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
PPM - parts per million
ND - not detected

TABLE 4 - CONTINUED

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 19, AST 3909
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC19-B09	19SSB0901	1	7
	19SSB0902	2	7
	19SSB0903	3	10
	19SSB0904	4	10
	19SSB0905	5	>50
CNC19-B10	19SSB1001	1	7
	19SSB1002	2	7
	19SSB1003	3	7
	19SSB1004	4	10
	19SSB1005	5	>15
CNC19-B11	19SSB1102	2	0
	19SSB1104	4	5
CNC19-B12	19SSB1201	1	0
	19SSB1202	2	4
	19SSB1203	3	6
	19SSB1204	4	0
CNC19-B13	19SSB1301	1	0
	19SSB1303	3	0
	19SSB1304	4	35
CNC19-B14	19SSB1401	1	0
	19SSB1402	2	0
	19SSB1403	3	11
	19SSB1404	4	10
	19SSB1405	5	70
CNC19-B15	19SSB1501	1	0
	19SSB1502	2	0
	19SSB1503	3	2
CNC19-B16	19SSB1601	1	0
	19SSB1602	2	0
	19SSB1603	3	123
	19SSB1604	4	18
CNC19-B17	19SSB1701	1	4
	19SSB1702	2	4
	19SSB1703	3	4
	19SSB1704	4	4
	19SSB1705	5	4
CNC19-B18	19SSB1801	1	1
	19SSB1802	2	4
	19SSB1803	3	4
	19SSB1804	4	4

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
PPM - parts per million

TABLE 4 - CONTINUED

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 19, AST 3909
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

ND - not detected

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC19-B19	19SSB1901	1	4
	19SSB1902	2	4
	19SSB1903	3	4
	19SSB1904	4	4
CNC19-B20	19SSB2003	3	60
	19SSB2004	4	>120
	19SSB2005	5	>50
CNC19-B21	19SSB2103	3	10
	19SSB2104	4	10
	19SSB2105	5	5
CNC19-B22	19SSB2201	1	3
	19SSB2202	2	3
	19SSB2203	3	6
	19SSB2204	4	10
CNC19-B23	19SSB2301	1	0
	19SSB2302	2	0
	19SSB2303	3	0
	19SSB2304	4	0
CNC19-B24	19SSB2401	1	0
	19SSB2402	2	0
	19SSB2403	3	0
	19SSB2404	4	0
CNC19-B25	19SSB2501	1	0
	19SSB2502	2	0
	19SSB2504	4	0
CNC19-B26	19SSB2602	2	4

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
PPM - parts per million
ND - not detected

TABLE 5

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
SITE 18, BUILDING 123
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data (ug/kg)[1]					
			Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	Diesel Range Organics (mg/kg)
CNC18-B01	18SFB01-0203	2-3	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC18-B02	18SFB02-0405	4-5	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC18-B03	18SFB03-0405	5-6	<5.0	<5.0	<5.0	<5.0	29	<10
CNC18-B04	18SFB04-0405	4-5	<5.0	<5.0	<5.0	9.6	13	<10
CNC18-B05	18SFB05-0809	8-9	<5.0	<5.0	<5.0	<5.0	<5.0	<10

NOTES:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
ug/kg - micrograms per kilogram, except as noted.
mg/kg - milligrams per kilogram.

TABLE 5 - CONTINUED

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
SITE 19, BUILDING 3909
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data (ug/kg)[1]					
			Benzene	Toluene	Ethylben zene	Total Xylenes	Naphthalene	Diesel Range Organics (mg/kg)
CNC19-B02	19SFB02-0406	5-6	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B03	19SFB03-0507	5-6	<5.0	<5.0	<5.0	<5.0	170	<10
CNC19-B04	19SFB04-0304	4-5	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B05	19SFB05-0405	5-6	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B06	19SFB06-0506	5-6	<5.0	<5.0	<5.0	<5.0	93	55
CNC19-B08	19SFB08-0506	4-5	<5.0	<5.0	<5.0	5.6	460	<10
CNC19-B08[2]	19SFB08-0506	4-5	NA	NA	NA	NA	NA	<10
CNC19-B09	19SFB09-0405	4-5	<5.0	<5.0	<5.0	<5.0	620	140
CNC19-B10	19SFB10-0405	4-5	<5.0	<5.0	<5.0	<5.0	460	44
CNC19-B11	19SFB11-0405	4-5	<5.0	<5.0	<5.0	<5.0	700	300
CNC19-B12	19SFB12-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B13	19SFB13-0405	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	22
CNC19-B14	19SFB14-0203	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B15	19SFB15-0203	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	16
CNC19-B15[2]	19SFB15-0203	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	NA
CNC19-B16	19SFB16-0203	2-3	<5.0	<5.0	<5.0	<5.0	1300	150
CNC19-B16[2]	19SFB16-0203	2-3	NA	NA	NA	NA	NA	176
CNC19-B17	19SFB17-0405	5-6	<5.0	<5.0	<5.0	<5.0	<5.0	23
CNC19-B17[2]	19SFB17-0405	5-6	NA	NA	NA	NA	NA	24
CNC19-B18	19SFB18-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B18[2]	19SFB18-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	NA
CNC19-B19	19SFB19-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B20	19SFB20-0304	3-4	<5.0	<5.0	<5.0	<5.0	27	<10
CNC19-B21	19SFB21-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC19-B22	19SFB22-0304	3-4	<5.0	<5.0	<5.0	<5.0	<5.0	<10

NOTES:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
[2] Duplicate Sample
ug/kg - micrograms per kilogram, except as noted.
mg/kg - milligrams per kilogram.

TABLE 6

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 18, BUILDING 123
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Laboratory Screening Data (ug/kg)[1]					
		Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	Diesel Ra Organic (mg/kg
CNC18-B01	18GFB01-06	<1.0	<1.0	<1.0	<1.0	<1.0	0.1
CNC18-B02	18GFB02-12	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1
CNC18-B02[2]	18GFB02-12	NA	NA	NA	NA	NA	<0.1
CNC18-B03	18GFB03-08	<1.0	<1.0	<1.0	<1.0	23	NA
CNC18-B04	18GFB04-09	<1.0	<1.0	<1.0	<1.0	10	0.4
CNC18-B05	18GFB05-12	<1.0	<1.0	<1.0	<1.0	6.4	NA

NOTES:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
[2] Duplicate sample
ug/kg - micrograms per kilogram, except as noted.
mg/kg - milligrams per kilogram.
NA = Not analyzed

TABLE 6 - CONTINUED

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 19, BUILDING 3909
ZONE G, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Laboratory Screening Data (ug/L)[1]					
		Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	Diesel Range Organics (mg/L)
CNC19-B02	19GFB02-08	<1.0	<1.0	<1.0	<1.0	<1.0	0.1
CNC19-B03	19GFB03-08	<1.0	<1.0	<1.0	3.1	120	3.4
CNC19-B04	19GFB04-08	<1.0	<1.0	<1.0	<1.0	5.8	0.8
CNC19-B05	19GFB05-08	<1.0	<1.0	<1.0	<1.0	3.1	0.7
CNC19-B06	19GFB06-08	<1.0	<1.0	1.8	<1.0	14	0.5
CNC19-B07	19GFB07-08	<1.0	<1.0	<1.0	<1.0	35	0.4
CNC19-B09	19GFB09-09	<1.0	<1.0	<1.0	1.3	130	1.6
CNC19-B10	19GFB10-10	<1.0	<1.0	<1.0	<1.0	22	6.0
CNC19-B11	19GFB11-07	1.5	<1.0	<1 0	<1.0	450	1.4
CNC19-B12	19GFB12-07	<1.0	<1.0	<1.0	<1.0	<1.0	0.2
CNC19-B13	19GFB13-07	6.5	<1.0	<1.0	2.9	1900	27
CNC19-B13[2]	19GFB13-07	NA	NA	NA	NA	NA	27
CNC19-B14	19GFB14-09	<1.0	<1.0	<1.0	<1.0	15	0.8
CNC19-B14[2]	19GFB14-09	<1.0	<1.0	<1.0	<1.0	7.9	NA
CNC19-B15	19GFB15-07	<1.0	<1.0	<1.0	<1.0	<1.0	0.3
CNC19-B16	19GFB16-07	32	<1.0	4.2	4.7	1400	2.9
CNC19-B17	19GFB17-11	<1.0	<1.0	<1.0	<1.0	<1.0	0.3
CNC19-B18	19GFB18-09	<1.0	<1.0	<1.0	<1.0	6.2	0.1
CNC19-B19	19GFB19-09	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1
CNC19-B20	19GFB20-09	<1.0	<1.0	<1.0	<1.0	<1.0	0.1
CNC19-B21	19GFB21-09	3.1	<1.0	<1.0	1.9	1600	5.6
CNC19-B22	19GFB22-09	1.5	<1.0	<1.0	<1.0	28	1.2
CNC19-B22[2]	19GFB22-09	3.3	<1.0	<1.0	<1.0	44	1.1

NOTES:
[1] Laboratory screening data were analyzed using USEPA Method 8260. Compounds not detected are reported as less than the instrument detection limit.
[2] Duplicate Sample
ug/L - micrograms per liter, except as noted.
mg/L - milligrams per liter.
NA = Not analyzed.

TABLE 7

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 18, BUILDING 123
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC18-B01 / 18SLB010203	14-May-99	< 6	< 6	< 6	< 6	< 400	< 400	< 400	< 400	< 400	< 6
CNC18-B02 / 18SLB020405	14-May-99	< 6	< 6	< 6	< 6	< 460	< 460	< 460	< 460	< 460	< 6
CNC18-B03 / 18SLB030405	4-May-99	< 6	< 6	< 6	< 6	< 360	< 360	< 360	< 360	< 360	5 [J]
CNC18-B03[3] / 18SLB030506D	17-May-99	< 7	< 7	< 7	4 [J]	< 400	< 400	< 400	< 400	< 400	3 [J]
CNC18-B04 / 18SLB040405	4-May-99	< 6	< 6	< 6	< 6	< 360	< 360	< 360	< 360	< 360	< 6
CNC18-B05 / 18SLB050406	14-May-99	< 10	< 10	< 10	< 10	< 530	< 530	< 530	< 530	< 530	< 10
CNC18-TL[2] / 1801TL00103	13-May-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5
CNC18-TL[2] / 1802TL00201	13-May-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

[2] Trip blank

[3] Duplicate sample

[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 7 - CONTINUED

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC19-B03 / 19SLB030506	14-May-99	< 6	< 6	< 6	< 6	< 530	< 530	< 530	< 530	< 530	< 6
CNC19-B06 / 19SLB060506	14-May-99	< 6	< 6	< 6	< 6	< 430	< 430	< 430	< 430	< 430	< 6
CNC19-B08 / 19SLB080405	14-May-99	< 6	< 6	56	92	< 4600	< 4600	< 4600	< 4600	< 4600	7250 [J]
CNC19-B09[3] / 19SLB090405	14-May-99	< 6	< 6	< 6	< 6	< 500	< 500	< 500	< 500	< 500	660
CNC19-B09 / 19SLB090405D	14-May-99	< 900	< 900	< 900	< 900	< 500	300 [J]	< 500	260 [J]	< 500	1500
CNC19-B10 / 19SLB100405	4-May-99	< 850	< 850	< 850	< 850	< 530	< 530	< 530	< 530	< 530	5500
CNC19-B11 / 19SLB110405	4-May-99	< 6	< 6	< 6	6 [J]	< 400	< 400	< 400	< 400	< 400	200 [J]
CNC19-B16 / 19SLB160203	14-May-99	< 7	< 7	< 7	< 7	< 460	< 460	< 460	< 460	< 460	5 [J]

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

[2] Trip blank

[3] Duplicate sample

[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 7- CONTINUED

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC19-TL[2] / 19TL00101	3-May-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5
CNC19-TL[2] / 1902TL00201	13-May-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in micrograms per kilograms (ug/kg).
NA - Not analyzed
[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.
[2] Trip blank
[3] Duplicate sample
[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 18, BLDG 123 and AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC18M-01 / 18GLM0101	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC18M-02 / 18GLM0201	9-Sep-99	3 [J]	< 5	< 5	4 [J]	137	< 10	< 10	< 10	< 10	< 10	< 5
CNC18M-02 / 18GLM0201D	9-Sep-99	< 5	< 5	< 5	3 [J]	227	< 10	< 10	< 10	< 10	< 10	< 5
CNC18O-1E / 18GLO1E01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC18O-1F / 18GLO1F01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC18M-03 / 18GLM03D01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC18TL[3] / 18TL00101	9-Sep-99	< 5	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

[3] Trip blank

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8 - CONTINUED

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 18, BLDG 123 and AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Lead (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Cadmium (ug/L)	Total Chromium (ug/L)	Mercury (ug/L)	Selenium (ug/L)	Silver (ug/L)
RBSL[1]		15	50	2000	5	100	2	50	5
CNC18M-01 / 18GLM0101	9-Sep-99	< 1.2	< 2.07	114	< 1.94	< 4 31	< 0.02	< 2.57	< 2.54
CNC18M-02 / 18GLM0201	9-Sep-99	< 1.7	< 3.6	18.8	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54
CNC18M-02 / 18GLM0201D	9-Sep-99	< 1.09	< 2.07	27.3	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54
CNC18M-03 / 18GLM03D01	9-Sep-99	< 3.27	< 6.21	58.4	< 1.94	< 4.31	< 0.02	< 7.71	< 2.54
CNC18O-1F / 18GLO1F01	9-Sep-99	< 1.09	20.3	59.4	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

TABLE 8 - CONTINUED

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC19M-01 / 19GLM0101	6-Aug-99	15	< 5	< 5	< 5	98	< 10	< 10	< 10	< 10	< 10	< 5
CNC19O-1B / 19GLO1B01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC19O-1D / 19GLO1D01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC19O-1C / 19GLO1C01	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC19M-02 / 19GLM0201	6-Aug-99	< 5	< 5	< 5	< 5	14	< 10	< 10	< 10	< 10	< 10	< 5
CNC19M-03 / 19GLM0301	9-Sep-99	< 5	< 5	< 5	< 5	12	< 10	< 10	< 10	< 10	< 10	< 5
CNC19M-04 / 19GLM0401	6-Aug-99	4 [J]	< 5	< 5	4 [J]	157	< 10	< 10	< 10	< 10	< 10	< 5
CNC19M-05 / 19GLM0501	10-Aug-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC19M-06 / 19GLM0601	9-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

[3] Trip blank

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 9

COMPARISON OF MAXIMUM CONCENTRATIONS TO RBSLs
SITE 18, UST 123 and Site 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Maximum Concentration in Soil (mg/kg)	Soil RBSLs (mg/kg)[a]	Maximum Concentration in GW (mg/L)	Tier 1 GW RBSLs (mg/L)[b]	GW RBSLs Protective of On-Site Construction Worker[c]
Benzene	**<0.9**	0.005	**0.31**[d]	0.005	0.15
Toluene	<0.9	1.622	**4.65**[d]	1	5.38
Ethybenzene	<0.9	1.260	0.1[d]	0.7	6.05
Xylenes	<0.9	42.471	0.79[d]	10	102.33
Benzo(a)anthracene	<4.6	73.084	-	0.010	-
Benzo(b)fluoranthene	<4.6	29.097	-	0.010	-
Benzo(k)fluoranthene	<4.6	231.109	-	0.010	-
Chyrsene	<4.7	12.998	-	0.010	-
Dibenzo(a,h)anthracene	<4.6	87.866	-	0.010	-
Naphthalene	**7.25**	0.21	**23.35**[d]	0.010	1.63

(a) - From Risk-Based Corrective Action for Petroleum Releases, Table B4, Sandy Soil, Depth to GW - <5 ft, SCDHEC RBCA Guidelines, 1998.
(b) - From Risk-Based Corrective Action for Petroleum Releases, Table B1, SCDHEC RBCA Guidelines, 1998.
(c) - Calculated for dermal, incidental ingestion, and inhalation routes for the on-site construction worker (see Section 3.5.1 of the text and Appendix H).
(d) - Groundwater concentration in equilbrium with free product as calculated using Raoult's Law (see Appendix F).
GW - Groundwater
RBSLs - Risk Based Screening Levels
ND - Not detected
NA - Not analyzed
Bold value indicates the concentration exceeded one of the RBSLs.

TABLE 10

EXPOSURE PATHWAY ASSESSMENT - CURRENT LAND USE
SITE 18, UST 123 and Site 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

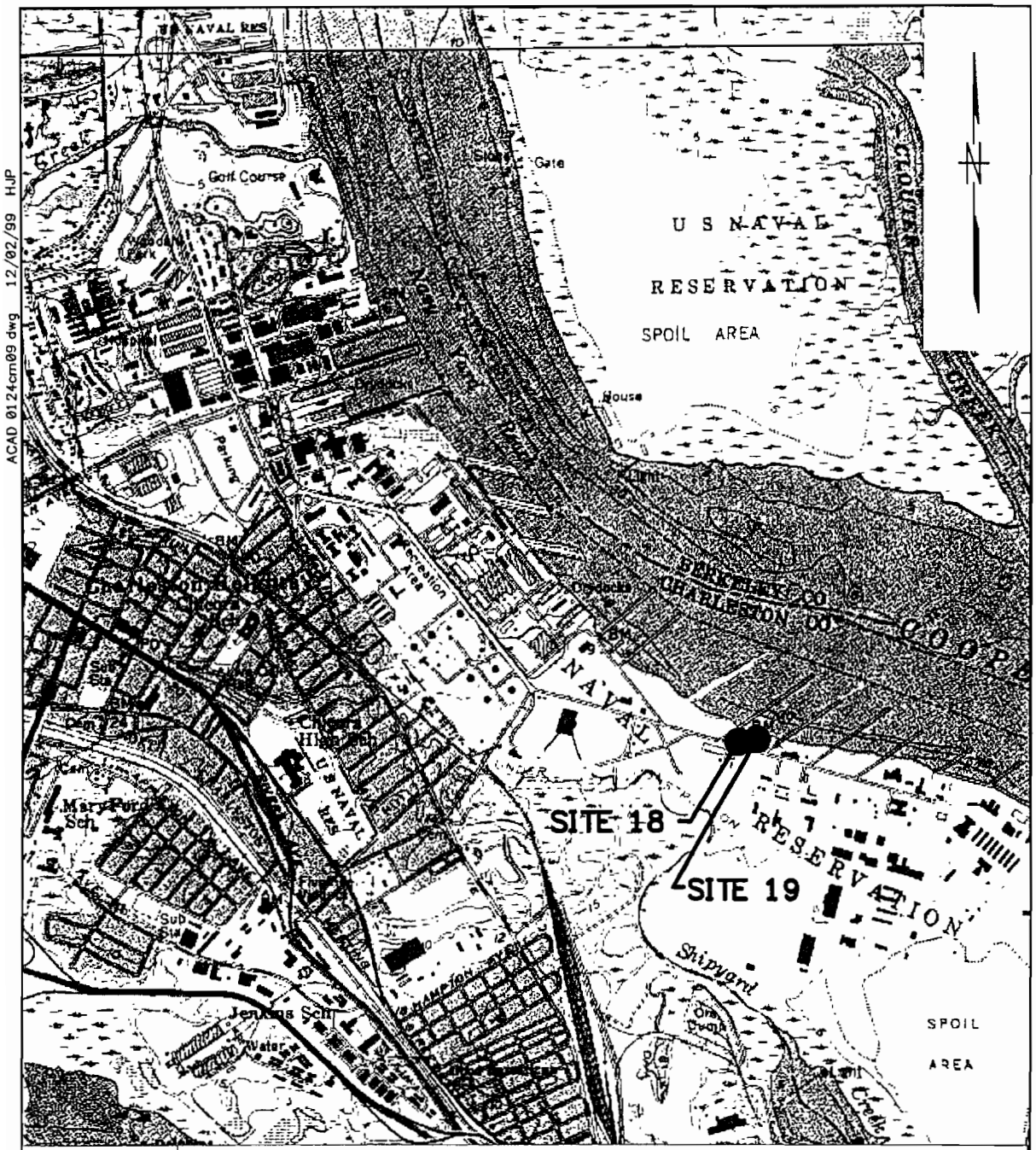
Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	No	No explosion hazard.	
Groundwater	Ingestion	No	No water supply well downgradient or residential basements.	
	Dermal contact	No		
	Inhalation	No		
Surface Water	Ingestion	No	Cooper River 200 ft downgradient	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No subsurface soil with BTEX or PAHs including naphthalene above RBSLs	
	Dermal contact	No		
	Inhalation	No		

TABLE 11

EXPOSURE PATHWAY ASSESSMENT - FUTURE LAND USE
SITE 18, UST 123 and Site 19, AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	No	No explosion hazard.	
Groundwater	Ingestion	Yes	Future use of property expected to be industrial or commercial. Water line within 5 ft of free product plume; therefore, construction worker exposure possible.	
	Dermal contact	Yes		
	Inhalation	Yes		
Surface Water	Ingestion	Yes	Cooper River 200 ft downgradient	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	Yes	Construction worker expsoed to soils during digging/trenching.	No additional data required
	Dermal contact	Yes		
	Inhalation	No	Inhalation not considered due to volatile loss during digging; no confined space entry; and low volatility of naphthalene	

FIGURES

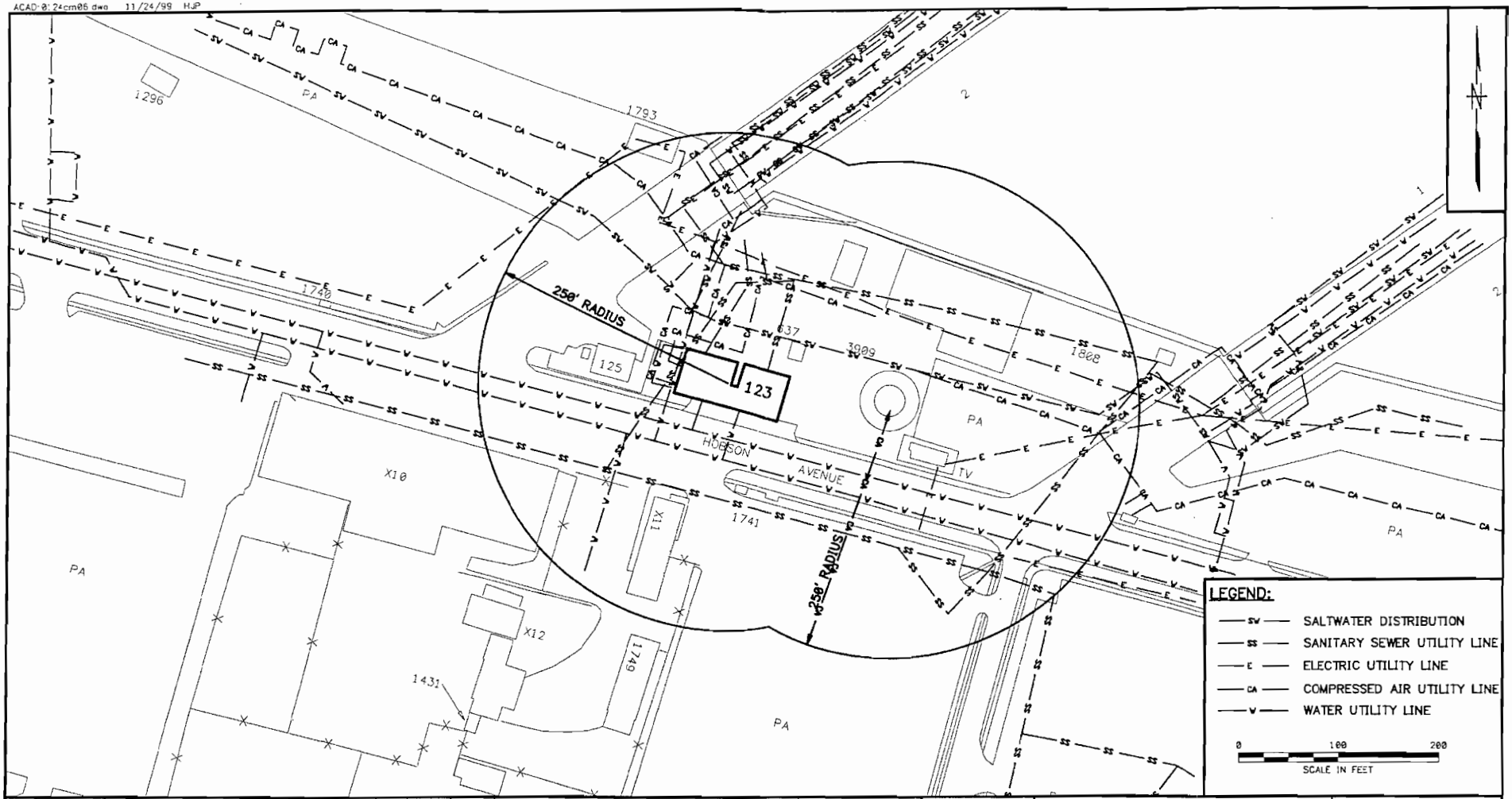


ACAD 0124cm09.dwg 12/02/99 HJP

DRAWN BY DATE: HJP 8/20/99		SITE LOCATION MAP SITE 18, BUILDING 123 AND SITE 19 AST 3909 ZONE G, CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA	CONTRACT NO. N0124
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED–AREA			APPROVED BY DATE
SCALE: AS NOTED			DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

ACAD: 0: 24cm06.dwg 11/24/99 HJP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

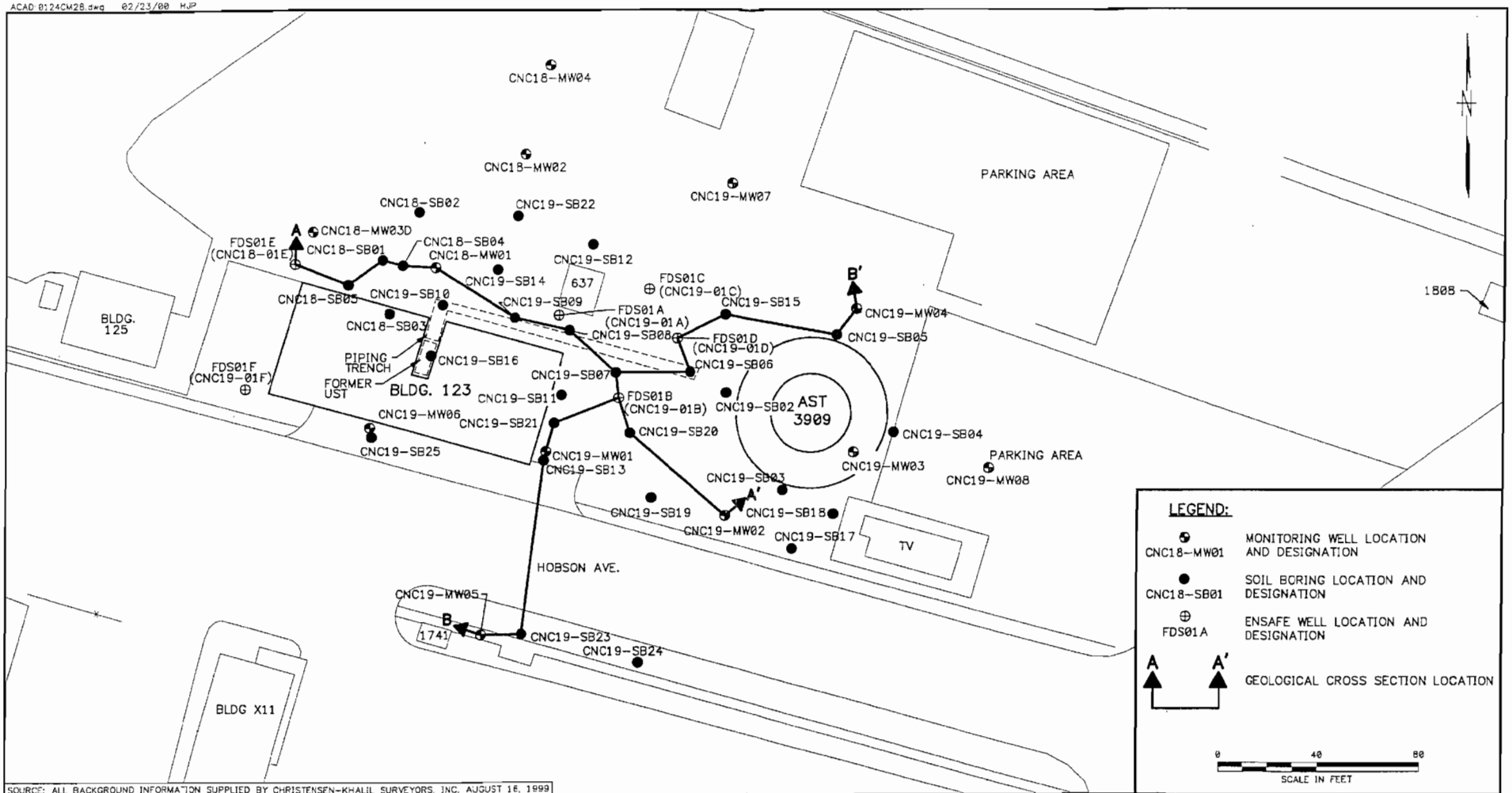
DRAWN BY HJP DATE 8/18/99
CHECKED BY DATE
COST/SCHED–AREA
SCALE AS NOTED

SITE VICINITY MAP
SITE 18, BUILDING 123
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2
REV. 0

FORM CADD NO. SDIV_BHDWG - REV 0 - 1/20/98

ACAD: 0124CM28.dwg 02/23/00 HJP



SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC. AUGUST 16, 1999

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

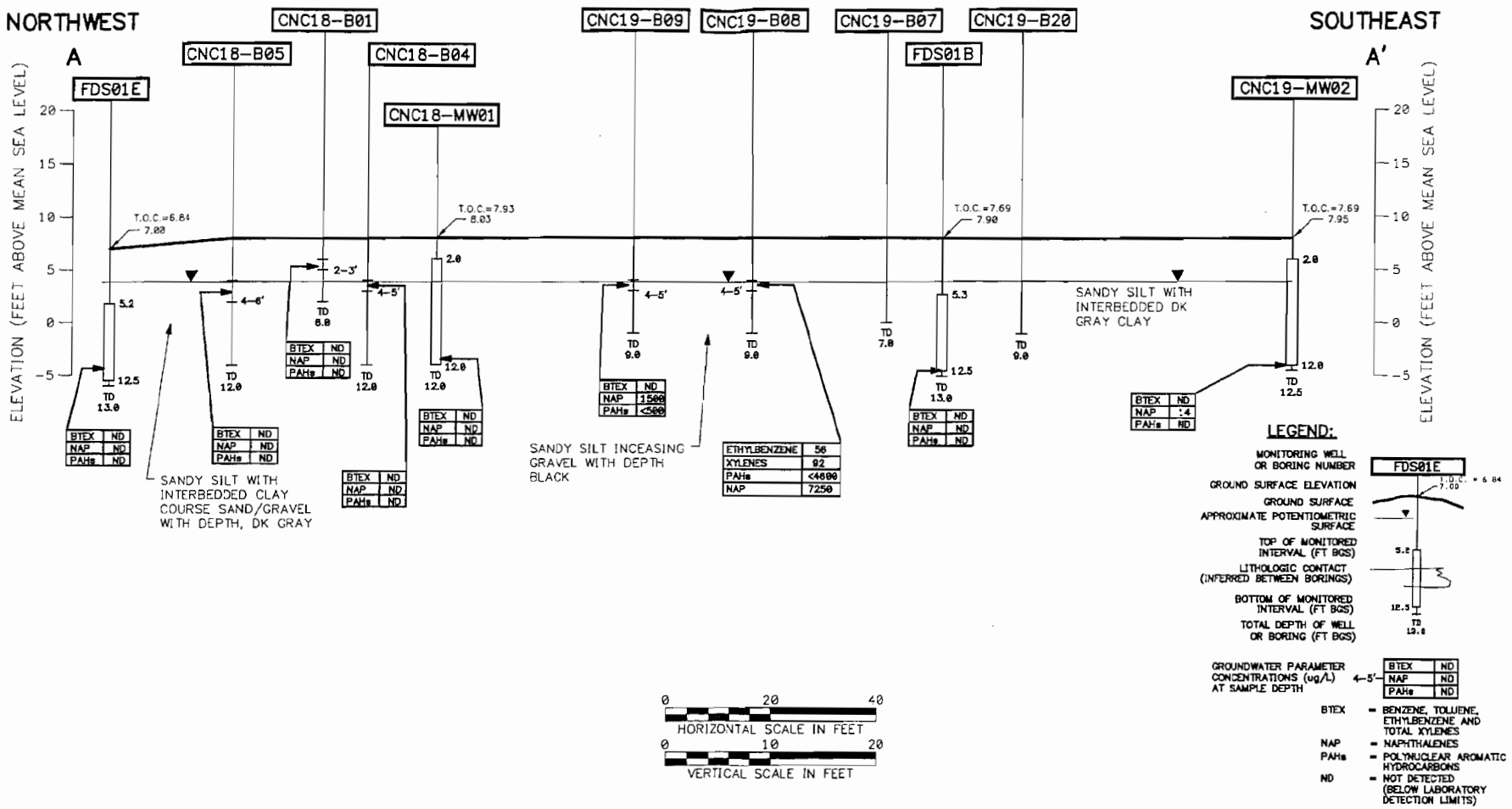
DRAWN BY MF DATE 10/25/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE PLAN AND SAMPLING LOCATIONS
SITE 18 BUILDING 123 AND
SITE 19 AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3
REV. 0

FORM CADD NO. SDN_BH.DWG - REV 0 - 1/20/98

ACAD: 0124GX07.dwg 11/15/99 HJP



LEGEND:

MONITORING WELL OR BORING NUMBER — FDS01E

GROUND SURFACE ELEVATION — T.O.C. = 6.84 / 7.00

GROUND SURFACE

APPROXIMATE POTENTIOMETRIC SURFACE

TOP OF MONITORED INTERVAL (FT BGS) — 5.2

LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)

BOTTOM OF MONITORED INTERVAL (FT BGS) — 12.5

TOTAL DEPTH OF WELL OR BORING (FT BGS) — TD 13.0

GROUNDWATER PARAMETER CONCENTRATIONS (ug/L) AT SAMPLE DEPTH — 4–5' — BTEX ND / NAP ND / PAHs ND

BTEX = BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENES

NAP = NAPHTHALENES

PAHs = POLYNUCLEAR AROMATIC HYDROCARBONS

ND = NOT DETECTED (BELOW LABORATORY DETECTION LIMITS)

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/15/99

CHECKED BY DATE

COST/SCHED–AREA

SCALE AS NOTED

GEOLOGIC CROSS SECTION A–A'
SITE 18, BUILDING 123 AND
SITE 19 AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124

APPROVED BY DATE

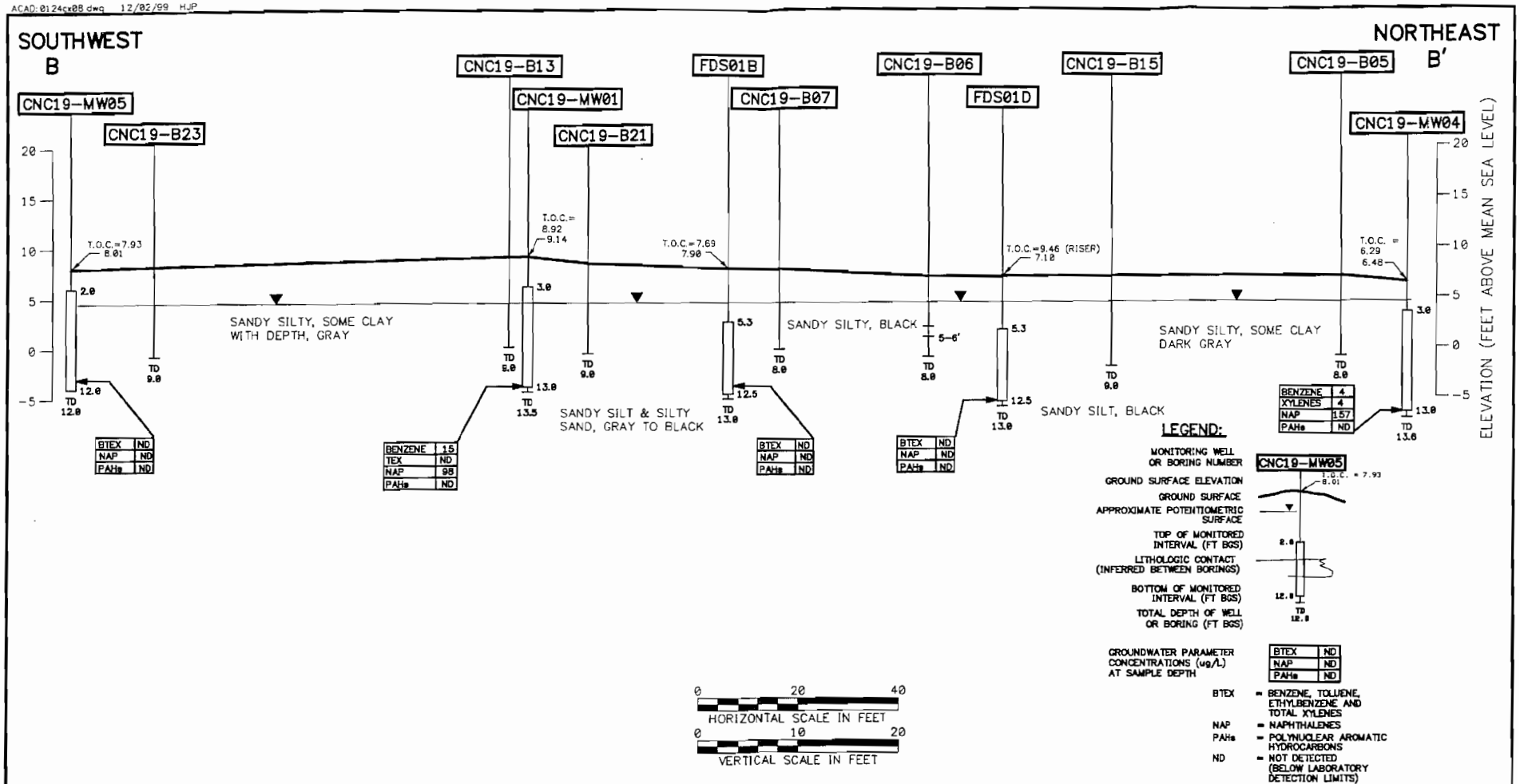
APPROVED BY DATE

DRAWING NO. FIGURE 4

REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

ACAD: 0124cx08.dwg 12/02/99 HJP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP 11/15/99 DATE
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

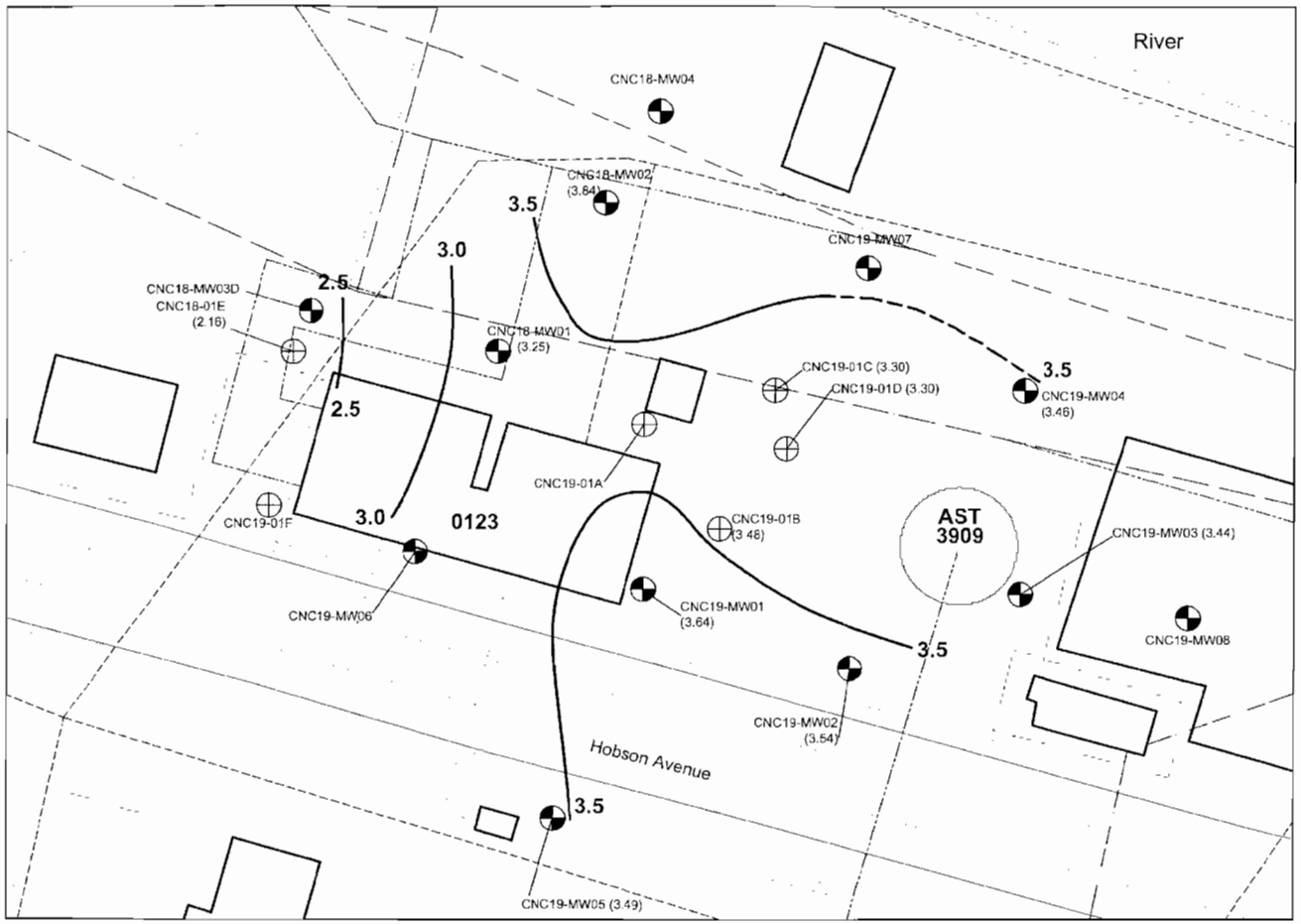
GEOLOGIC CROSS SECTION B-B'
SITE 18, BUILDING 123 AND
SITE 19 AST 3009
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 5
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

File: GW Elev
Date: 04/25/01

EGIS: Charleston Naval Complex



Legend:

Samples: Subsurface Soil Samples

Samples: Groundwater Samples
- Groundwater Well
- Groundwater Well
- Road Lines
- Text Road Text
- Pavement
- River Bank

Utilities:
- Sanitary Sewer Line
- Salt Water Distribution Line
- Water Utility Line
- Electricity Line
- Compressed Air Line

SWMU/AOC:
- Buildings
- Zone Boundary

Groundwater Contours:
- 3.5 Groundwater Potentiometric Surface Contour (FT MSL; Dashed where inferred)
- (3.46) Potentiometric Surface Elevation

N
W E
S

Scale (ft)
0 80

REV#	DATE	DESCRIPTION	APP'D

J.A. JONES ENVIRONMENTAL SERVICES
Member Employee-Owned Company
A Subsidiary of J.A. Jones Environmental Services

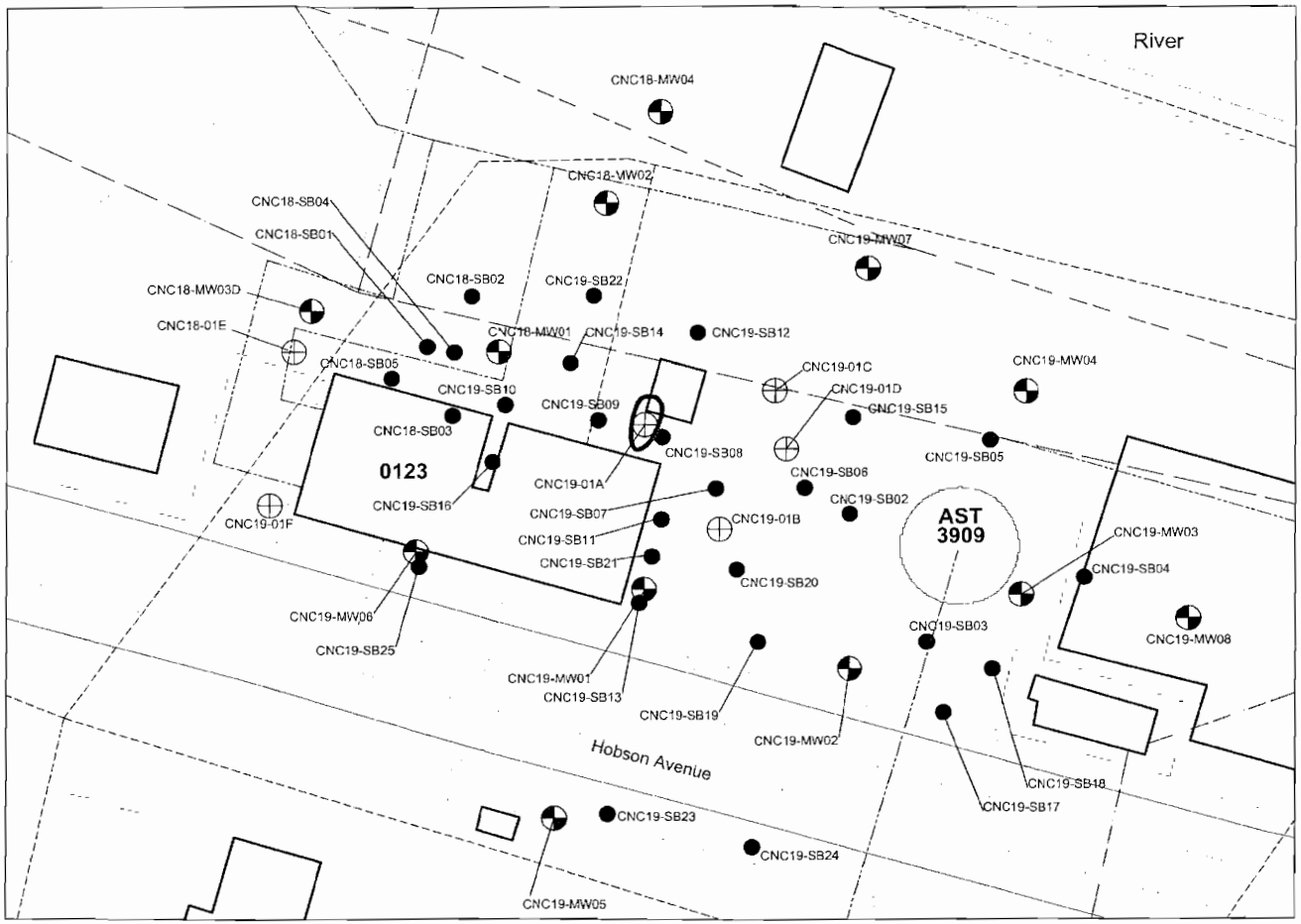
Groundwater Potentiometic Map - 10/9/99

Site 18 - Building 123, Site 19 - AST 3909, Zone G,
Charleston Naval Complex, North Charleston, South Carolina

DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/25/01
APP'D:	**FIGURE 6**

File: Free Product
Date: 04/25/01

EGIS: Charleston Naval Complex



Legend:

Samples: Subsurface Soil Samples
- Soil Boring

Samples: Groundwater Samples
- Groundwater Well
- Groundwater Well
- Road Lines
- Text — Road Text
- Pavement
- River Bank

Utilities:
- Sanitary Sewer Line
- Salt Water Distribution Line
- Water Utility Line
- Electricity Line
- Compressed Air Line

SWMU/AOC
- Buildings
- Zone Boundary

Free Product:
- 0 — Estimated Extent of Free Product

N
W E
S

Scale (ft)
0 80

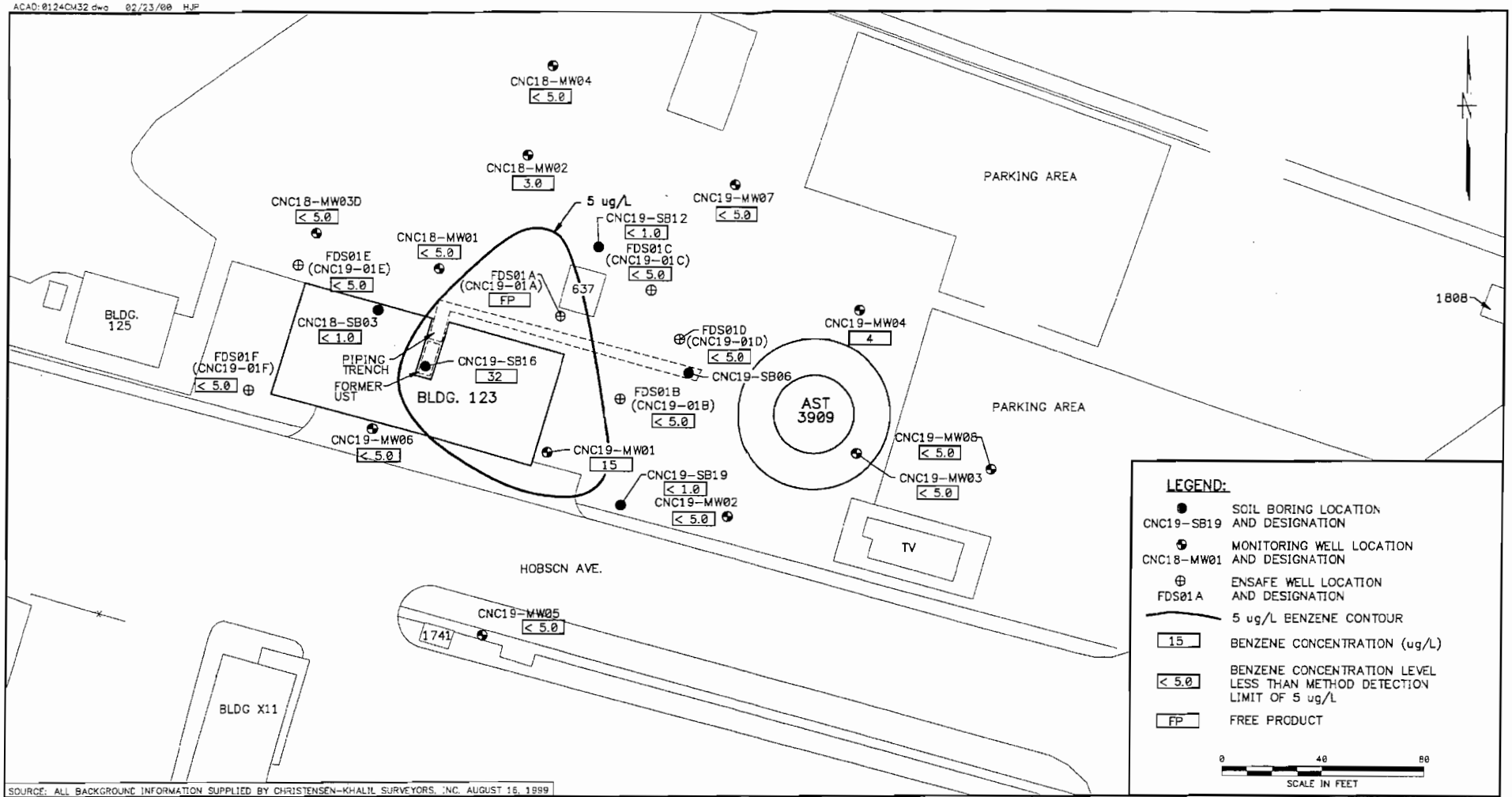
REV#	DATE	DESCRIPTION	APP'D

J.A. JONES ENVIRONMENTAL SERVICES

Estimated Extent of Free Product
Site 18 - Building 123, Site 19 - AST 3909, Zone G,
Charleston Naval Complex, North Charleston, South Carolina

DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/25/01
APP'D:	**FIGURE 7**

ACAD:0124CM32.dwg 02/23/00 HJP



LEGEND:

- ● CNC19-SB19 — SOIL BORING LOCATION AND DESIGNATION
- ◒ CNC18-MW01 — MONITORING WELL LOCATION AND DESIGNATION
- ⊕ FDS01A — ENSAFE WELL LOCATION AND DESIGNATION
- 5 ug/L BENZENE CONTOUR
- 15 — BENZENE CONCENTRATION (ug/L)
- < 5.0 — BENZENE CONCENTRATION LEVEL LESS THAN METHOD DETECTION LIMIT OF 5 ug/L
- FP — FREE PRODUCT

0 40 80
SCALE IN FEET

SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC. AUGUST 15, 1999

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 10/26/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

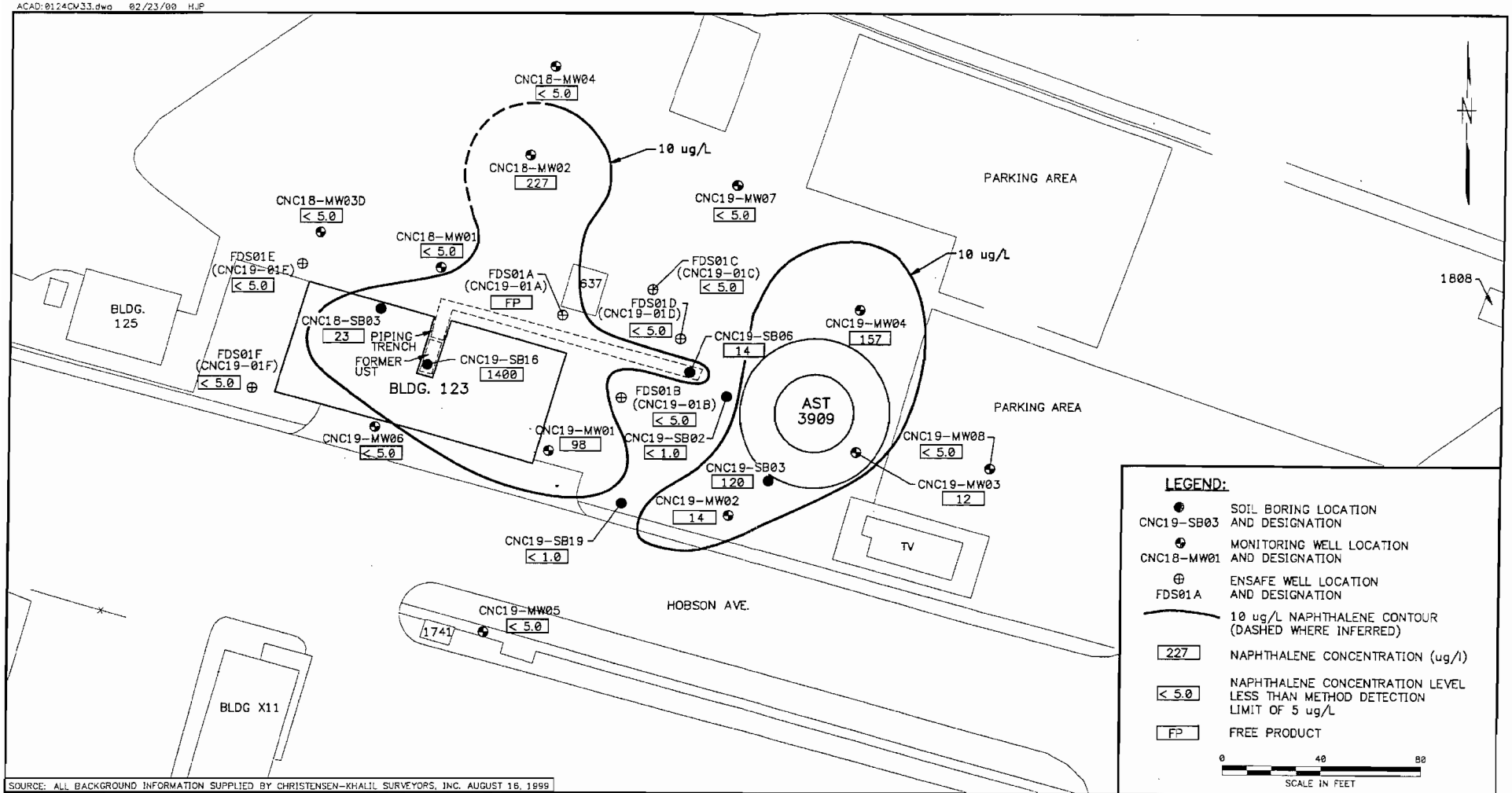
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

GROUNDWATER BENZENE CONCENTRATION MAP
SEPTEMBER 9, 1999
SITE 18 BUILDING 123 AND
SITE 19 AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 8
REV. 0

FORM CADD NO. SDM_BH.DWG - REV 0 - 1/20/98

ACAD:0124CM33.dwg 02/23/00 HJP



SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC. AUGUST 16, 1999

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 10/26/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

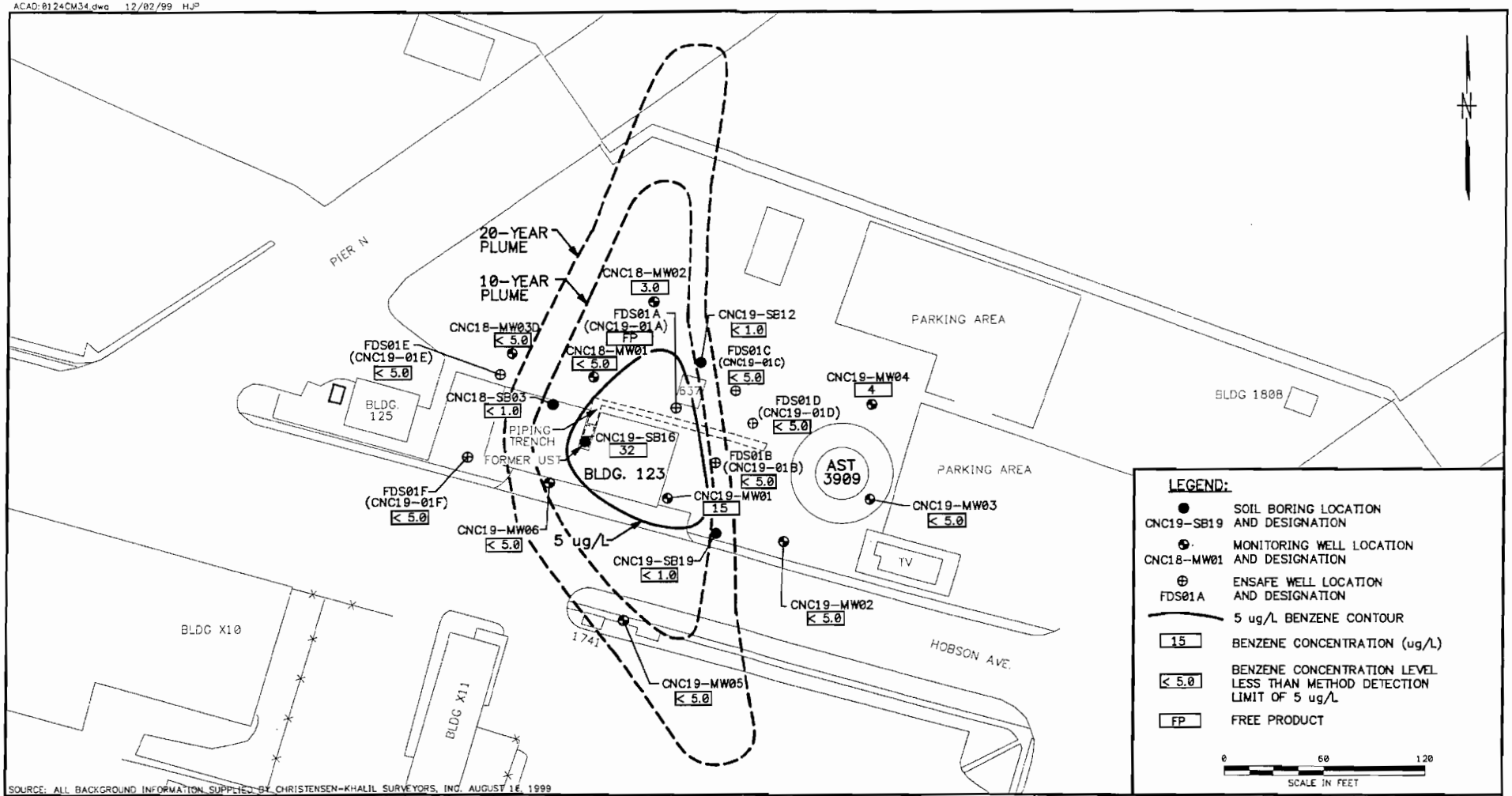
DEPARTMENT OF THE NAVY · NAVAL FACILITIES ENGINEERING COMMAND

GROUNDWATER NAPHTHALENE CONCENTRATION MAP, SEPTEMBER 9, 1999
SITE 18 BUILDING 123 AND
SITE 19 AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 9
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

ACAD: 0124CM34.dwg 12/02/99 HJP



SOURCE: ALL BACKGROUND INFORMATION SUPPLIED BY CHRISTENSEN-KHALIL SURVEYORS, INC. AUGUST 16, 1999

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

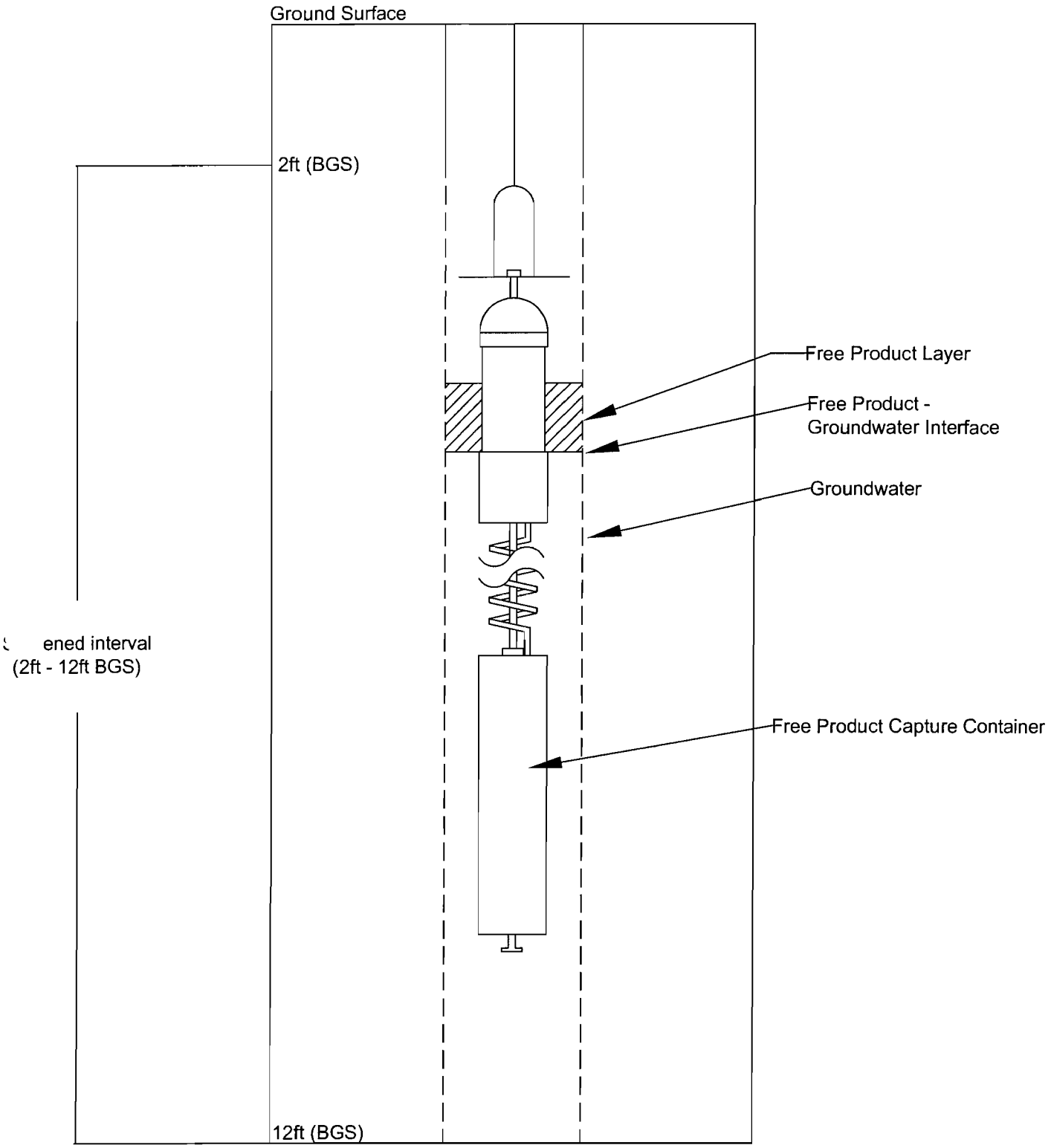
DRAWN BY MF DATE 11/22/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

10-YEAR & 20-YEAR PLUME MIGRATION PREDICTION OF BENZENE
SITE 18 BUILDING 123 AND
SITE 19 AST 3909
ZONE G, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0124
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 10
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

File Well Constr
Date 04/25/01



REV#	DESCRIPTION	APP'D

J.A. JONES
ENVIRONMENTAL
SERVICES
McLaren-Hart/Jones
A subsidiary of J A Jones Environmental Services

Well Construction

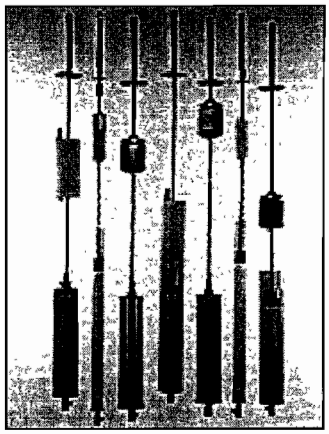
Site 18 Building 123 & Site 19 AST 3909 Zone G,
Charleston Navy Complex, Charlteston, NC

DRWN: DTB	NOT TO SCALE
CHK'D:	DATE: 04/25/01
APP'D:	**FIGURE 12**

APPENDIX A

REMEDIAL EQUIPMENT – PASSIVE SKIMMER

OIL SKIMMERS



SOS-P
SPG-P

Applications:
Skimming (LNAPL)

Passive Floating-Intake Skimmers
SOS-P Reduce Product Lense to a sheen
SPG-P High Viscosity Hydrocarbons

OVERVIEW

Unlike any other design, these unique Passive Skimmers can be upgraded to fully automatic, active Product Only Recovery Systems. They are designed to recover free-floating hydrocarbon from any depth down to a sheen (? 0.01 inches) without the need for any power source. The floating intake head (which in two configurations: SOS and SPG) follows water table fluctuations. Passive Skimmers include versions for 2-inch (5cm) and 4-inch (10cm) diameter wells, and Tidal Passive Skimmers with extra long strokes are available for sites with high and low tide considerations.

Passive Skimmers consist of four main items: a Floating Intake Head, Guide Rod & Flexible Tube, a Well Centering Disk, and a Clear Product Canister.

PASSIVE OPERATION

The skimmer is lowered into the well until the midpoint of the skimmer's travel is located at the fluid level in the well. The support rope is tied off holding the skimmer at a specific depth and the skimmer is left in the well to collect floating hydrocarbons.

A floating intake head follows any water table fluctuation.

Hydrocarbon first enters the skimmer through the floating intake's outer debris screen and then an inner oileophilic hydrophobic screen, down through a flexible, yellow tube, and into the see-through canister.

To empty the skimmer, it is pulled to the surface and the canister is drained using the valve at its base. The skimmer is returned to the well until next checked at its predetermined maintenance interval.

SKIMMER CAPACITY

18-inch canister : 13.0 oz. (0.38 l)
36-inch canister): 25.5 oz. (0.75 l)
18-inch canister): 47.0 oz. (1.4 l)
36-inch canister : 94.0 oz. (2.8 l)

OPERATIONS AND ACCESSORIES

CEE Passive Skimmers have three upgrade options that are simply undertaken in the field. All conversions require simple tools and do not take longer than thirty minutes. Should it be needed, reverse upgrading back to the standard Passive SOS Skimmer is an easy process that involves the same upgrade steps in reverse order.

CANISTER UPGRADE. CEE Passive Skimmers come in stock canister lengths ranging from 12 - 36 inches with ranging capacities from 8.5 oz. (0.25 L) to 94 oz. (2.8 L) depending on canister diameter. (Other sizes are available dependent on site requirements.) Furthermore, canisters can be removed and replaced as capacity or compatibility demands change.

HAND-PUMP UPGRADE. Most CEE Passive Skimmers, when outfitted with a skimmer-to-surface product tubes, can be serviced without raising the skimmer out of the well. Using a pump at the surface, maintenance personnel can pump product out of the skimmer's product canister and into a portable collection canister at the surface.

FULLY AUTOMATIC PRODUCT RECOVERY UPGRADE. CEE Passive Skimmers can be upgraded to active, fully automatic Product Only Recovery Systems as site needs change. As active systems, product can be recovered at rates over 2000 gpd. Safety and protective features are available such as Tank-Full Shut-Off (TFSO), which turns off the system when the product tank becomes full, and High-Water Shut-Off (HWSO), which turns off the product pump temporarily when water levels rise above the skimmer's effective travel. (Part

Number for upgrade is 300031.)

Click here to download a Site Information Form. Fill it out and fax it to CEE.

This is the shortest path to a solution.

For more information call 800 537-1767 (Toll Free in North America) or (510) 891-0880 ,e-mail CEE directly at sales@cee.com or contact the sales office nearest you.

BACK TO THE MAIN PAGE

OIL SKIMMERS

SOS

Selective Oil Skimmers

SOS Models:

SOS-2 For 2-inch wells; five models for tidal, dual pump, high-water, and shallow wells
SOS-4 For 4-inch wells; six models for tidal, dual pump, high-water, and shallow wells

OVERVIEW

The family of Selective Oil Skimmers (SOS) when coupled with shallow or deep-well product pumps, are designed to recover free-floating hydrocarbon down to a sheen (< 0.01 inches) from depths up to 250 feet (76m). The floating intake head follows water table fluctuations and with optional features, such as High-Water Shut-Off (HWSO), will automatically turn off the product pump temporarily to prevent potential water contamination. Alternate size SOS Skimmers are available for operating in 2-inch (5cm) and 4-inch (10cm) diameter wells. Tidal skimmers with extra long strokes are also available for sites with high and low tide considerations.

The SOS Skimmer consists of three main items: a Floating Intake Head, Guide Rod & Flexible Tube, and 2 Well Centering Disks.

METHOD OF OPERATION

The skimmer is lowered into the well until the midpoint of the skimmer's travel is located at the fluid level in the well and then connected to a surface or down-well mounted product pump.

The skimmer has a floating intake head that follows the fluctuating water table. Hydrocarbon first enters the skimmer through the floating intake's outer debris screen and then an inner oileophilic hydrophobic screen, down through a flexible, yellow tube, through the product pump, and into a product storage tank.

FLOATING INTAKE HEAD

All product which enters the floating intake head passes down through the flexible tube, up into the hollow guide tube, and is drawn out of the well by a product pump.

The Floating Intake Head:

- Consists of an outer debris screen, a floatation collar, and an inner semi-permeable (selective) screen which allows liquid hydrocarbons to pass and repels water.
- Reduces product level to a sheen (< 0.01 in.).
- Floats at the product-water interface in the well and automatically adjusts to any fluctuation of the groundwater within its travel range.
- Slides on a hollow, stainless steel guide tube which passes down through the center of the skimmer head.
- Is connected to the guide tube via a flexible (fuel rated) tube which hangs below the skimmer head and guide tube.

SKIMMER OPTION

SOS Skimmers can be used in conjunction with groundwater depression. When using SOS Skimmers, the groundwater hose must go along side the skimmer itself. The SOS Skimmer is placed inside a slotted PVC tube so the water depression hoses do not interfere with the floating intake skimmer head. CEE can provide either pneumatic or electric water depression pumps, depending upon the water drawdown rate.

Click here to download a Site Information Form. Fill it out and fax it to CEE.
This is the shortest path to a solution.

For more information call 800 537-1767 (Toll Free in North America) or (510) 891-0880 ,e-mail CEE directly at sales@cee.com or contact the sales office nearest you.